SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

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TECHNOLOGY COPY

WHEN THE CANAL BARGE TAKES THE ELEVATOR TO SCALE THE HILLS.—[See page 18.]

Scientific American Publishing Co., Munn & Co., New York

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With the Editors

OUR globe-trotting member has been very busy ever since his return, answering questions about his psychic experiences. He has had little time to recall the other aspects of his trip, and everybody has been too busy asking him about the psychic part of his journey to manifest any interest in the ordinary incidents of travel in a foreign land. As he now looks back at these, he finds them far from dull. Many of the impressions which he would otherwise have are submerged in the confused jumble which represents his present recollections of a wild scramble from Paris, through Amsterdam and Berlin and Munich and Zurich and back to Paris again, all in the space of eight days—of which two were spent in Berlin and one in Munich, and the other five, plus one of the nights, on the trains. It will be noted that he entered and left Germany across neutral frontiers.

NOW our globe-trotting member had a "hunch" that this was the way to avoid unpleasantness; and this was confirmed on inquiry at the Bureau of Information in the Gare du Nord, at Paris. In response to his request to be informed on the most convenient and most expeditious way to get to Berlin, he was met by the calm and reiterated statement that "One is not permitted to go to Berlin." He finally got by the attendant, by displaying his American passport in this mad folly of going to Berlin. In Germany they felt the same way about it; every shop or restaurant of any consequence displayed a sign reading, usually, "No service to French or Belgians"; or occasionally, the more severe ultimatum "No admission to . . ."

HE scattered thousand-mark notes with a lavish hand among the porters and taxi-drivers of Germany; then, after exchanging an incredible number of thousands of marks at the bank in Romanshorn for something like eight and a quarter Swiss francs, he tipped the gendarme on the station platform one franc for some very useful information. The officer seemed to regard him as a benefactor of the city, but the editor felt like a beggar to descend to such a paltry scale of tipping as a single unit of currency. He learned that one can travel for 15 hours, from Berlin to Munich, for 90 cents—or proportionately more if one adopts the second or first class travel which is more fitting for an American millionaire.

THE stamp collector finds the SCIENTIFIC AMERICAN offices quite productive of all kinds of foreign stamps. There is not a day that the editorial mail does not include a sprinkling of foreign stamps. Indeed, the editors keep pretty well informed as to the changes in stamp designs, which seem to be quite frequent during these days of readjustment in many corners of the globe. But cardinal interest centers about those pieces of mail which come from Germany and Austria, whose depreciated currency is reflected by the fantastic denominations of the stamps. Thus the usual letters received from Dr. Alfred Gradenwitz, our Berlin correspondent, carry 300 marks' worth of stamps. Yet Dr. Gradenwitz has standardized the size of his photographic prints so that all of them may be placed in those square envelopes so characteristic of Continental letters, together with the manuscript typed on thin paper. On the other hand, and in sharp contrast, we receive occasional photographs and accompanying text from a Berlin photographer. These come in bulky packages plastered with thousands of marks' worth of German stamps, and one cannot help worrying about the expenditure of such big sums of marks for mere postage, until one recalls that a single accepted contribution, when paid for at prevailing rates of exchange, may buy hundreds of thousands of marks. So the situation is not so serious for the contributor as it would appear on the surface.

UNDER the heading "Unprecedented Demand for Old Papers" appearing in the SCIENTIFIC AMERICAN of 75 years ago, we read the following: "At the commencement of the present volume of the SCIENTIFIC AMERICAN we had nearly one thousand complete sets of the preceding volume on hand. Since that time we have had five hundred copies of those sets bound, and the balance have been ordered by mail and sent in sheets. We are now obliged to inform our patrons we are unable any longer to furnish complete sets in sheets, and we have but fifty more bound copies left." Little wonder that the early bound copies of the SCIENTIFIC AMERICAN are so scarce in our day.

AFTER an extensive investigation into the house shortage situation, we have come into possession of considerable first-hand information on that very important question—are present-day houses properly built? Our investigator has gone out on the jobs himself, chatted with the carpenters and masons, called on the lumber companies, consulted building inspectors, and in every other way gathered first-hand impressions. It appears that a large proportion of the houses now being constructed throughout the country are being honestly and lastingly built. New methods of construction are being introduced to offset the high cost of materials and labor, and many of these new methods have much to commend them. It is a mistaken idea that we must forever construct houses as in the days of our forefathers, when lumber was the main material employed and it could be used with a lavish hand because of its low cost. On the other hand, there is a good deal of hurried, careless and cheap work going into many houses. Too often the builder, after he has received his payment, does not care how shabby a house will become. And the worst feature of the situation is that the average house buyer is quite unfamiliar with building materials and methods, and judges his purchase merely by appearances. Obviously, it is difficult to unshuffle the bad from the good; for, by the very nature of a house, it is unnecessary purposely to camouflage bad work. The walls, when completed, conceal it. Our report on the situation will appear next month.

AUTOMOBILE statistics at a glance, in the form of simple graphic comparisons; the present state of radio development not only as regards the broadcasting situation but more particularly the development of radio receiving equipment; diamond mining in Colombia; the application of carrier current communication to the broadcasting of music and talks over telephone lines and electric transmission systems; the magnitude of the canning industry with special reference to fruits and vegetables—these are but a few of the features of our forthcoming August issue which, we hope, will be more varied and more interesting than ever.

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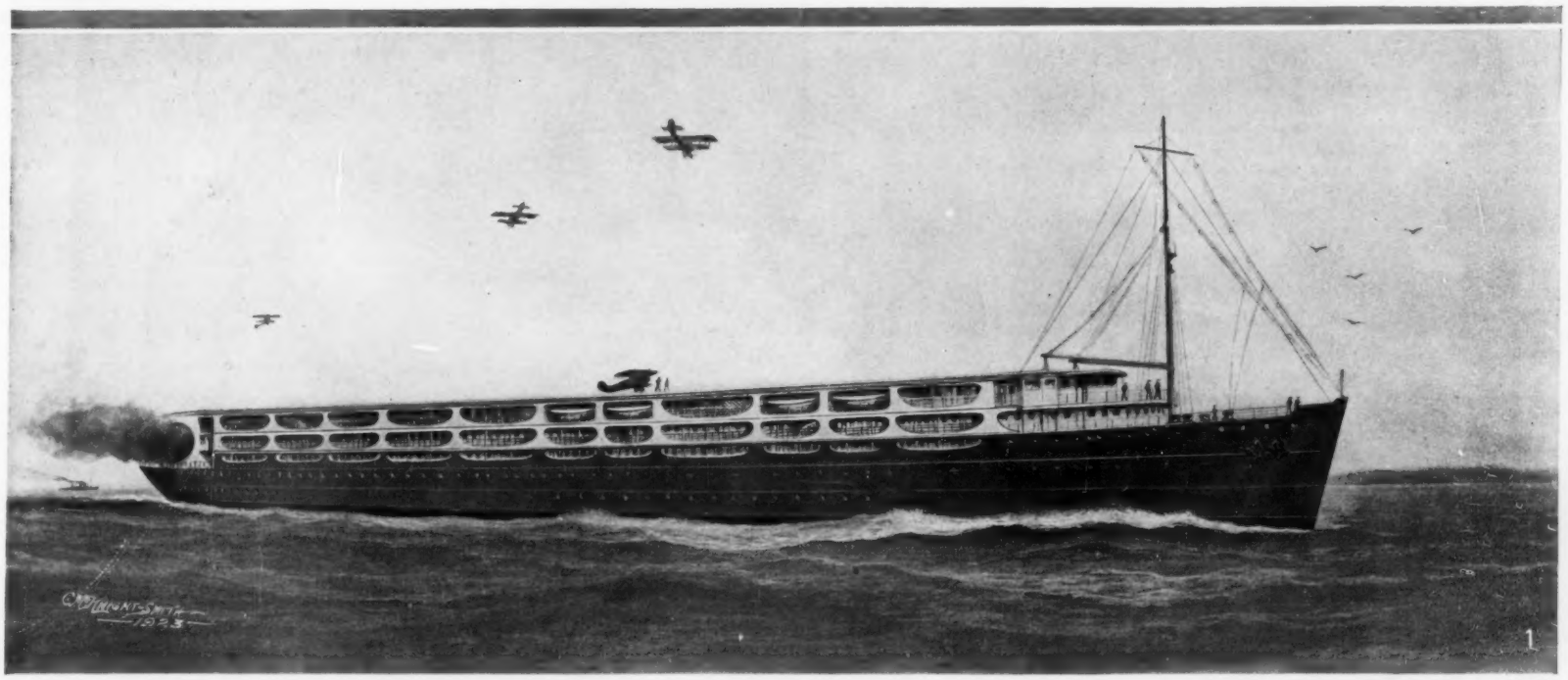
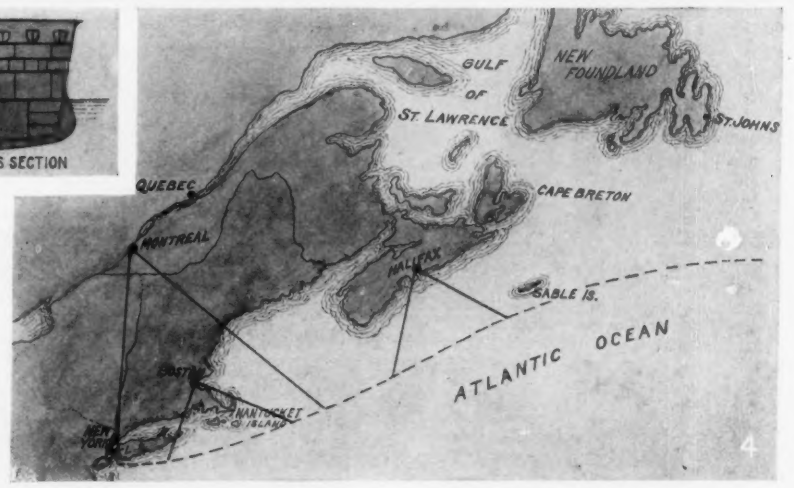
SEVENTY-NINTH YEAR

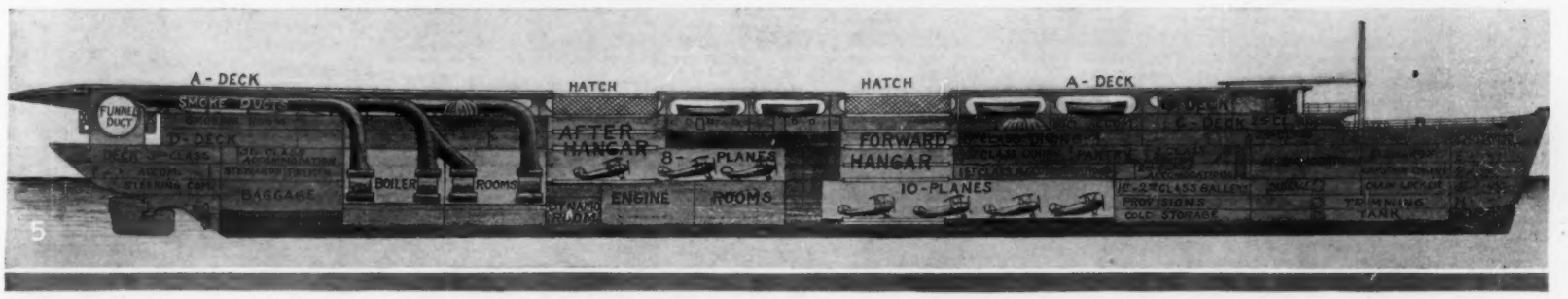
SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JULY, 1923







1. Proposed aircraft-carrying mail steamer in mid-Atlantic. 2. Land's End to Suez, showing by dotted line the track of steamer, by full lines the airplane tracks to and from landing places. 3. Midship section; note the bulges for stability and steadiness. 4. Chart of north-eastern Atlantic seaboard, with steamer and airplane tracks. 5. Longitudinal section, showing flying deck, passenger accommodations, airplane hangars, engine and boiler rooms with smoke ducts discharging astern

Ocean travel by combined steamship and airplane **[see page 16 for description]**

Trapping the Burglar

Clever Devices Put Forward by Inventive Genius for Catching the Prowler at His Work

By Edward H. Smith

EARLY in 1863, His Highness, the Duke of Brunswick, hired a valet. As was his custom, the deposed Charles Frederick Augustus William exercised both care and caution in the choice of this new body servant. He spent many weeks over the problem and finally settled upon one, Shaw, a Britisher who had apparently served several noble English houses and come away with the most glowing testimonials, all of which the ducal German had examined with anxious eyes. Shaw arrived in April, came to terms with his new master and was installed.

The circumspection with which the duke moved was natural. On his dethronement in 1830, he had removed to a great old house in Paris, carrying with him a treasure of about three million dollars in jewels and gold. His collection was famous and the refugee prince understood that he and his hoard were the objectives of constant plots among European crooks. Accordingly, his Paris house was most strangely and marvelously fitted with defenses in the nature of special locks and bolts, iron doors, watchmen and alarm contrivances. Every European inventor of new kinds of anti-burglar devices found a ready customer in the duke, and certainly no house on the continent could show curious and ingenious defenses to match those to be found in the ducal quarters.

Even the radio telephone has been enlisted in running down the thief. Here is how the New York Police Department broadcasts an alarm to everybody

The store of jewels was kept in a huge iron safe of French or German manufacture, which stood in a specially constructed alcove opening from the ducal bedroom—a retreat which might now be called a vault. This alcove was closed with a heavy iron door fitted with padlocks of intricate design. Once this door was got open, there stood the vast safe, again locked with a series of contrivances and—what is of particular interest here—defended by not one but three set-gun arrangements. If any rash robber attempted to open the door of the safe without the proper keys and the secret of handling them so as not to release the triggers, he was certain to receive the fire of these formidable batteries of revolvers and slug guns—enough to dispatch an elephant.

No one but the duke himself had the keys and only he understood the complete intricacies of his defenses. As a rule, he permitted no one else to be present in his bedroom when he opened the doors of the vault and safe, as he did at intervals, either to gloat over his treasures with miserly emotion or to display some of his gems to friends or to an autumnal inamorata.

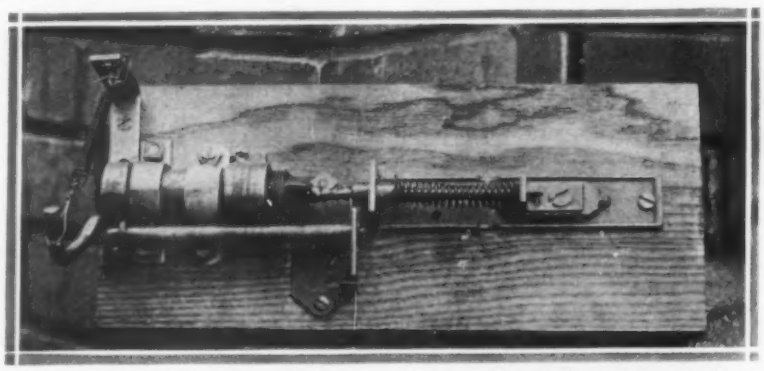
Such precautions had succeeded for more than 30 years. There had been plots and attempts without number, including one abortive attack on the duke's life, which he interpreted as an effort to get at his possessions. Now, however, he had himself opened the way to his hoard. Shaw, the new valet, was a notable British professional burglar. His references had all been forged and the hyper-cautious Brunswick prince had fallen before a trick which still succeeds in putting criminals into the households of the rich.

Shaw put in the first few months of his service getting the confidence of his master, a thing not too lightly accomplished. But once the fugitive princeling had been well beguiled, he trusted Shaw even to the extent of admitting that he actually owned some jewelry and that it was somewhere about the house. The servant had, to be sure, discovered the iron door of the vault on his first day in the house, obviously hidden as it was behind heavy velvet portieres near the head of the bed.

The new valet seized the first opportunity for examination. When his master had gone out and the other servants were elsewhere, he drew aside the portieres and inspected the locks of the vault door. Two of them, he saw, could be picked without great difficulty. The other was of a well known make and he consequently anticipated ease in procuring its key through confederates. This job was shortly accomplished, and the next time the duke left the house his valet promptly opened the vault door and beheld the fearsome aspect of the safe. Not only was it protected by the batteries of shooting irons, he found to his surprise, but it was electrically wired, surely the first strong-box in Europe to be so equipped.

This wiring was mere child's play compared to modern installations of the type. It is, however, for more than one reason, worth attention. The electric wires on the duke's safe led to bells in various parts of the house, which would begin to clamor the moment any one tried to force the safe door or tamper with its locks. This was a revolutionary idea and the only part of the duke's defenses with which the burglar had not been familiar from the beginning.

Just how far beyond the imagination of men the electric bell was at this time may be seen from the experiences of Mr. Edwin Holmes, the originator of the well known central office burglar alarm system which bears his name. Holmes's device was originally no more than a mechanism by which an alarm bell was sounded in the bedroom of the user or in some other part of the house distant from the door or window being attacked by the burglar. Only a few years before the episode of the Duke of Brunswick, Mr. Holmes had been forced to go about in Boston and New York with a miniature model of his installation, in order to prove that disturbing a switch at one point could set off a bell situated elsewhere. No one would believe him without being shown.



A home-made set-gun for garage use, which would probably put a terminus upon the burglar's career

Evidently some French electrician had achieved similar results a little later than the American inventor and probably independently. His device had been installed by the duke.

Mr. Shaw, valet and burglar, reclosed the door of the duke's vault with a sense of defeat. He could get to the safe door, right enough. Also, he was an expert in the matter of set-gun mechanisms and had hoped to be able to disconnect those of the duke without too much peril and trouble. But this new electric thing was something he had never experienced and was loath to engage. However, he did not despair. Instead he settled down to watch developments and keep his eyes open for a chance to discover the secret of the duke's wires.

Months passed without result and Shaw was thinking of resigning and returning to London. On December 17, 1863, however, the unexpected carelessness of every man played into his hands. The cautious Charles Frederick Augustus, etc., had decided to give a certain lady a few jewels for Christmas and had summoned a jeweller to consult with him about putting the gems into fresh settings. Preparatory to the goldsmith's arrival, the duke opened his vault and the door of the safe. Then he sat about, chafing and waiting. An accident had befallen the jeweller and he did not appear. After fuming for an hour, the duke impatiently closed and locked the vault door without having taken the trouble to reclose the door of the safe and put his set-guns and alarms into business order. So he quit the house, leaving a caustic message for the jeweller who was to be commanded to return that evening.

Shaw, of course, seized the golden opportunity, opened the locks of the vault door, filled his pockets with what seemed most readily salable of the duke's treasures and fled. But he was indiscreet enough to write letters and happily was arrested at Boulogne with the duke's diamonds in his pockets.

I choose the tale of His Highness of Brunswick to open this account of mechanisms by which men have sought to catch burglars because it reflects the transition from primitive arrangements of this sort to modern appliances. The set-guns with which he had rigged his safe were almost as old a contrivance as firearms themselves; the electric wires were and are as modern as anything save the wireless.

In this generation we hardly think of a burglar alarm or thief trap without electricity. Once men could not imagine such devices as made effective save by means of gunpowder. But the man trap is, of course, much older than either electricity or explosives. Primitive African tribes use pitfalls and snares against their enemies in battle and against invasion by thieves of their villages and cultivated lands. No doubt, such tricks were first employed back in paleolithic times in hunting game. We find the modern applications of these savage ideas in pitfalls which have been employed against poachers in Europe and in this country within memory.

In the days of Louis XIV of France, one of the royal safes was equipped with a bomb, arranged to explode in case the strong-box were forced open. Unhappily it blew up a trusted servant instead of a burglar. Accidents of this sort have gradually discouraged the use of the set-gun, which used to be primed behind the door of many an humble chicken coop and goods cellar. I recall such an incident from my own boyhood. A farmer in the vicinity had repeatedly been robbed by hog thieves and decided to end the depredations by means of a loaded shotgun set up in his stable and pointed at the door, whereto it was attached by a cord, which pulled the trigger when the door was pushed open. The farmer himself forgot what he had done and suffered the loss of a leg. Such mishaps gradually discouraged the employment of these dangerous mechanisms in community after community, but the set-gun is still in very common use, a matter to be discussed later.

If it were possible in the short space assigned me to go over the development of thief traps and burglar alarms in all antique times, a thing involving almost interminable research, it would certainly appear that every fresh advance in human knowledge had been employed in the ceaseless contest with the lawbreaker and especially the depredator of private property. The

early dynasts of Egypt were probably as much concerned with thieves as with the durability of their monumental labors. Khufu probably built his pyramid with an eye to the main consideration of protecting his trimillennial sleep and the treasures of his funeral vault against intrusive burglars—and failed. The rock-hewn tombs of later kings, now so much discussed, give the evidence of this, for they were not monuments at all but safes of stone, built to deceive and defy robbers. And witness the irony that only the crypt of the worthless Tutankhamen escaped, while all about him the two-legged jackals murdered the sleep and spoiled the reliquaries of illustrious great Pharaohs.

As civilization advanced and knowledge of new principles and forces came to men, all in turn were applied to the problem of defeating the thief—particularly the burglar. Every mechanical system has been used for this purpose. In its day steam was applied to the task. Explosives and electricity have already been mentioned. It is a fact, as witnessed by various applications to the patent office, that inventors are busy today at wireless alarm systems.

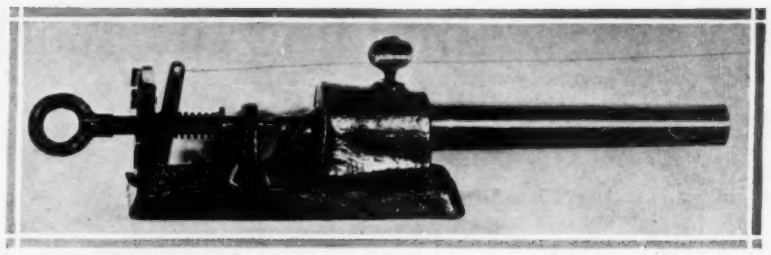
The pervasiveness of this problem in the minds of inventors of every period is only paralleled by the persistence of the robber. Any man possessing the divine patience to run through the gazette of patents for the last 30 years, let us say, would be appalled by the number and variety of anti-burglar devices. He would be convulsed with laughter at many of the listed devices and stunned by the ingenuity and intricacy of many others. A few samples will reveal enough.

Some years ago an inventor invaded the office of one of the largest burglar-alarm companies and presented his invention. It was a gilded or nickelled affair of metal, very like a hunting-case watch and designed to be hung on a chain and slipped into the vest pocket opposite that containing the watch, both the timepiece and this mechanism being attached to the same chain at opposite ends. Inside this metal contraption was a small blank cartridge, held against a plunger and trigger arrangement. If a pickpocket took hold of the chain and tried to lift the watch, off went the cartridge with a loud bang. Being enclosed in the metal case, the exploding powder was not expected to set the user ablaze, but one wonders what might have happened to the nervous gentleman who reached into the wrong pocket for his watch, or what riots might have happened on crowded subway trains when some "dip" got to work.

Another inventor developed a little mechanism based on the cap firing sticks used by children on the Fourth of July, with the difference that his cap shooter used a spring and trigger firer. A cord was run from the door knob to one end of the little device. Another cord connected the off end of the cap firer with the wall. If anyone opened the door there was an explosion, sufficient to frighten away any burglar ignorant enough not to know about the toy.

When I was much younger an inventor in the Middle West persuaded a local banker that he was in great danger of being robbed by hold-up men, with the result that a number of special trap doors were cut into the floor of the bank just before the tellers' cages. If a hold-up man entered the teller merely touched a button and the floor yawned beneath the robber, letting him down into a basement, where he could be captured at leisure. Unhappily, the mechanism went awry one busy Saturday morning, with the dire result that four valued depositors scooted into the oubliette, one of them sustaining a broken leg and another some sore bruises. Damage suits and the immediate removal of this invention resulted.

Within the memory of most of us, the principle of the electric chair was experimentally applied to the safeguarding of safes and vaults. Someone thought up the idea of placing metal mats all about safes and then attaching both these mats and the safe itself to a high voltage electric light circuit. Woe unto the burglar who trod upon those mats and touched that safe. Such an arrangement might have served well enough were it not for the trifling obstacles of the law and human fallibility. There happens to be no authority in the books for the private electrocution of safe crackers, and bank employees will forget to turn off the switches controlling such terrific mechanisms just as they will neglect to close windows and enter checks. This was, in fact, what happened in a small bank where this rash plan was tried. Fortunately the current was not strong enough to kill the forgetful cashier.



Another extremely deadly set-gun of the sawed-off shotgun type

To go into the matter of the alarms which have been devised to keep thieves and burglars out of private houses and apartments would be to write a catalogue. Catches on doors and windows which set off gongs by mechanical means are perhaps the commonest. Every inventive boy has fitted his father's house with something of the sort. Strings and cords stretched across rooms and apertures at night for the fumbling feet and hands of the burglar in the dark have been almost as numerous. When touched by an intruder such lines released a trigger or pulled out an electric plug, thereby setting a gong into violent agitation. This idea is still applied to some types of local gong alarms used in New York City. Devices for relocking windows and doors, cartridge exploders, rocket firers, whistle blowers, electrified common screens for summer use when windows are open, and many others needs to be noted. Years ago I saw a house equipped with an automatic lamp lighting system. All the gas jets were rigged with pilot flames which burned very dimly all night. If any burglar opened a door or lifted a window, the chains of the lamps were pulled by a mechanical contraption of wires and pulleys, with the result that the lights flared up. Later I saw this idea adapted to electric lighting.

Inside and outside views of a pocket equipped with the latest device for keeping out the prying pickpocket's fingers. The owner of the pocket gets in by pulling the string latch, as shown at the left

The weaknesses of all these plans are at once apparent to whoever has given the burglary question even desultory attention. Either the mechanisms are more perilous to the user than to the criminal or they are so readily defeated by any informed burglar as to render them worse than useless. As a result of the defects which appear in all alarm systems and in all else that is human, there has been a constant quest for the unbeatable alarm — a cry after perfection.

Needless to say, the impossible is achieved every little while in the fevered brain of some infatuated designer. Not long ago an inventor approached the officials of a prominent alarm company with the modest statement that he had it at last. On investigation his invention proved to be a device attachable to telephones, which would jiggle the receiver hook up and down rapidly in case any window or door lock were disturbed in the night, thus flashing to the central operator the message that a burglar was on the premises. All the hello girl had to do was to summon the police. Was this not simplicity and effectiveness to the point of purest beauty? It was—until the alarm man asked his friend what would happen if a burglar cut the wires.

Another and more dramatic incident of this sort happened to the same official. A very earnest young man came in with a burglar alarm device of which the central instrument was a series of glass tubes, almost filled with liquid, in which floated a cork transfixed by a copper wire. Electrical contacts were placed at the top and bottom of each tube. If the tubes or any one of them were broken the liquid ran out and the cork fell to the bottom, completing the circuit by means of its bit of copper wire and off went the alarm. If, on the other hand, the place took fire, the heat of the room would sufficiently expand the liquid to raise the cork to the top of the tube, again closing the circuit and giving the alarm.

"You see," said the young man, "I've certainly got it. There's no way to beat it. Is there?"

He stared at the alarm company's officer with defiance in his eye.

"Not unless you cut the wire," said the other.

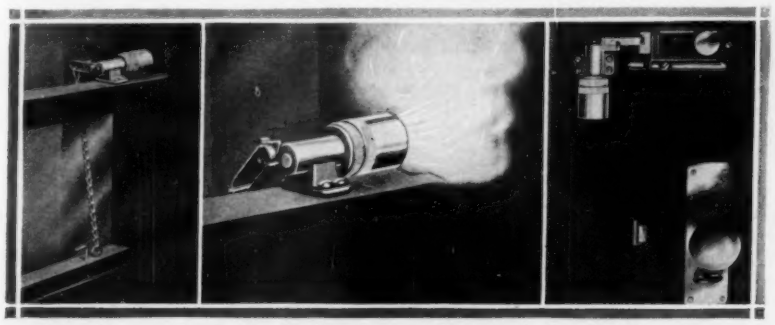
The inventor stiffened like a man shot, rose out of his chair, stood upright for a moment and then collapsed in a dead faint. When he had been revived he took his invention, tossed it contemptuously into his satchel and went away without a word. Zeal had betrayed him.

I have spoken above of the persistent use of explosives in burglar catching devices. The farmer's gun in the hen coop is, as indicated, far from obsolete, but inventors have lately been offering through the regular market a specially designed mechanism for the shooting down of nocturnal invaders. This consists of a simple mounting, to be screwed to a desk, table, window seat or shelf. To this is attached a short shotgun barrel of eight or ten inches in length, designed to receive an ordinary 12-gage shell. Behind the barrel is a spring trigger arrangement which is to be attached to a wire stretched across the room and fastened either to a door or window or to the opposite wall, the wire being drawn taut. The barrel of the gun is then aimed along the wire. If anyone, by opening a door or window, pulls on it during the night, or if an intruder stumbles against the wire in the dark he is directly in the line of fire and certain to receive the charge of shot. Such a mechanism is effective, of course, only when the burglar is ignorant of its presence. Its deadly nature will probably persuade many against it.

Set-guns have, nevertheless, played a dramatic part in the stories of many an American community, as witness the case of Charles Adams of Chester, Vermont. A number of years ago this quiet little community suffered from what the reporters love to call an epidemic of burglaries. Shops, factories, private houses and even stables were entered at night and everything was stolen, from a hen or bag of feed to half a merchant's stock of clothing. The local police and the irate citizens tried every manner of dodge, but caught no one of importance. When special vigils were being kept or definite plans operated for the apprehension of the burglars, no places were robbed. But as soon as the vigilance was relaxed and the town began to make up its mind that the robbers had passed on to some other community—well, there were fresh burglaries. It seemed that some one in the deepest confidence of the local officials must be directing the criminals.

One of the chief figures in the town's fight against its plague of intrusions was this man, Adams. He was head of the board of education, supervisor of the public library, ex-legislator, a bookish and studious man, an old resident, descended from locally distinguished ancestors and prosperous if not wealthy. He supplied the local vigilantes with more ingenious plans for thief catching than anyone else in the town, but the actual

(*Continued on page 69*)



Anti-burglar gas bomb, attached to door (right) or window (left), and tripped by an effort to open, as shown in the center

Building the World's Largest Monolith

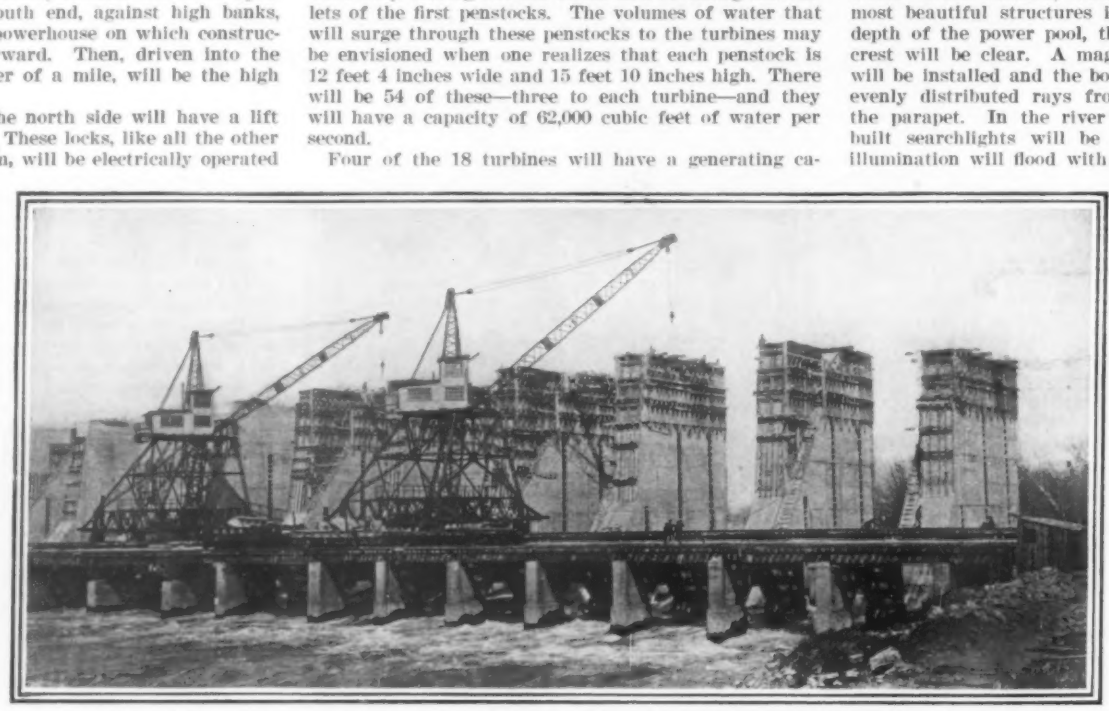
A Word Regarding the Far-Reaching Significance of Wilson Dam to Navigation and Industry

By Littell McClung

THE MOST significant effort in construction undertaken by the Government since building the Panama Canal, is the monolithic fashioning of Wilson Dam across the Tennessee River at the foot of Muscle Shoals in northwest Alabama. Under direction of War Department engineers, forces of men, many of whom are trained in dam building, are pushing the work night and day on this, the largest concrete form in the world. Wilson Dam will be not only the most massive structure of its kind, but it will be the greatest hydro-electric installation yet achieved.

The photographs reproduced herewith are the first showing the progress of the Government's effort. At present, work is in five main divisions. First, there are the lock chambers for navigation over the dam at the north end. Just beyond these rises the short non-overflow section. Across the two channels of the river and the island between them, extends the main spillway division. At the south end, against high banks, stands the half-finished powerhouse on which construction is rapidly going forward. Then, driven into the south banks for a quarter of a mile, will be the high core wall.

The two locks along the north side will have a lift of 45 feet 6 inches each. These locks, like all the other equipment on Wilson Dam, will be electrically operated by current from the generators. Some idea of their massiveness may be gained from the fact that the lock gates will weigh 1500 tons, and each of the 63 crest gates will weigh 33 tons. Orders will soon be placed with large manufacturers for some of this machinery, for which Congress recently appropriated $10,000,000. This cost is in addition to that for turbines, generators and much of the other electrical equipment. When completed, Wilson Dam will be 5000 feet long, 101 feet wide at foundations, and will lift its superstructure nearly 125 feet above the riverbed. To bring into existence such a monolith in a river where the flow sometimes reaches 500,000 cubic feet a second, all phases of the work must be synchronized—drilling, blasting and excavating; bringing in materials for making concrete; building flawless forms; transporting concrete to these forms; and the final pouring. To consolidate these factors in a continuous manner requires 27 miles of railroad, two dozen boats and barges, a number of electrical cranes, scores of rock drills, three huge crushing and mixing plants, 30 locomotives and more than 200 cars and gondolas.



Smooth and beautiful work on the main spillway section, showing the special piers that will carry the illuminated boulevard along the top of the Wilson Dam

The effort is truly gigantic and in some phases quite spectacular both as to engineering and construction. This may be realized when one considers that Wilson Dam will contain almost three times as much masonry as the Roosevelt Dam in Arizona, and that it will be 81,000 cubic yards larger than the Assouan Dam in Egypt—at present the giant among the world's river barriers.

There are few precedents to guide the various phases of the work, for the reason that this is the most massive dam ever undertaken and because it is being built in a limestone country where fissures may occur in the rock strata. While the general principles of gravity-dam construction are well known, Wilson Dam, like the Panama Canal, is a problem unto itself, and, in an engineering sense, a fascinating one.

The first natural enemy to be check-mated is upward pressure—the upward thrust of any water that may seep under the foundations. At the start, of course, the riverbed was exhaustively tested by diamond-drilling and hydraulic pressure. Then the solid rock was blasted out 16 feet deep across the stream. Into this channel the concrete foundations of the dam were "toed," making them virtually monolithic with the natural rock.

Throughout the length of the dam a tunnel is being constructed through the foundations close to the riverbed. From this tunnel 6-inch holes are drilled far down into the limestone beneath. There is one of these every 23 feet from bank to bank of the river. If upward pressure occurs from seepage these holes will act as relief valves, taking up the water and releasing it through pipes into the river below. And through them concrete will be shot down and driven, under air pressure, into any crevices through the rock, thus permanently sealing them.

Some of the most interesting work is that on the great powerhouse that will be 1184 feet long. The day the accompanying photographs were taken, workmen were busy tearing out the forms and revealing the outlets of the first penstocks. The volumes of water that will surge through these penstocks to the turbines may be envisioned when one realizes that each penstock is 12 feet 4 inches wide and 15 feet 10 inches high. There will be 54 of these—three to each turbine—and they will have a capacity of 62,000 cubic feet of water per second.

Four of the 18 turbines will have a generating capacity of 30,000 horsepower each. The other 14 will develop 36,000 horsepower each. The total maximum installation will be for 624,000 horsepower. And this energy, harnessed from the river's flow and pressure, will be supplemented by the 100,000 horsepower steam plant, built by the Government, that stands on the banks of the river a mile below the dam.

A fine problem in engineering and construction is presented in cementing the powerhouse forever into the limestone bluffs by means of a great core wall 1500 feet long. This core wall will be as high as the dam itself, seven feet thick at the base and will taper to five feet at the top. This immense, invisible water barrier, deep down in the rock under the earth, will for all time prevent any possible seepage around the power house end of the dam.

Before Wilson Dam is finished almost 1,000,000 yards of earth and stone will have been excavated from banks and river bed and 1,260,000 yards of concrete will have been poured. The work is under immediate direction of Colonel W. J. Barden, of the United States Army, and Government engineers associated with him. There will be no letup night or day until the project is completed at a cost of approximately $50,000,000.

A race with Nature is immediately ahead in building across the swift south channel a very high cofferdam nearly 700 feet long. As this article is written the engineers are concentrating every possible force on this cofferdam. Their determination is to have it finished by late summer, as summer and autumn constitute the low-water period in the Tennessee Valley. If this last cofferdam is completed on schedule, entirely diverting the south channel during low water, then the dam's foundations can here be blasted out and concrete pouring will raise this section of the structure to sufficient height for work to continue on it steadily through the high-water period of next winter.

A bascule bridge, spanning the locks at the north end, will join a concrete arch bridge over the main structure and by the power house. These bridges will have a boulevard surface and will carry double tracks for electric cars. The boulevard will be a link in three national highways—the Jackson Highway, from Chicago to New Orleans; the Lee Highway, from the Eastern Seaboard to the Pacific Coast; and the Scenic Highway, from Jacksonville, Florida, to Seattle, Washington.

Here and there the removal of the wood forms indicates the striking beauty and perfect uniformity of the work. When finished, Wilson Dam will be one of the most beautiful structures in America. Owing to the depth of the power pool, the waters flowing over the crest will be clear. A magnificent system of lighting will be installed and the boulevard will be swept with evenly distributed rays from reflectors sunken along the parapet. In the river below the dam especially built searchlights will be anchored. These fans-of-illumination will flood with brilliance the sheet-waters flowing over crest and apron and the volume of tumultuous tail-waters foaming out from the turbines. The idea back of this spectacular illumination is that the dam, being a link in three highways across the United States, will be visited annually by thousands of tourists and should be a creation of shining beauty as well as a generator of vast power.

In the coming great effort to make our swifter inland waters navigable, Wilson Dam is most significant. Industrial America is just beginning to catch a glimpse of the tremendous significance of navigation on mountain streams. Low-banked, slow-moving rivers like the lower reaches of the Ohio and Mississippi, do not carry boats and barges up into the heart of mineral resources. But their high tributaries and the other swift-flowing streams have cut their channels through the great iron and coal measures of the Appalachians. There are a number of such streams throughout the Eastern and Southern States. Of these, perhaps the most important is the Tennessee, with its tributaries uncovering the rich mineral regions of east Tennessee, western North Carolina, northern Georgia and northern Alabama.

As to navigation—to say nothing of power—Wilson Dam marks a definite change of policy after a century of open-channel work, with canals, on our swifter rivers. It is almost a certainty that in the future, navigation and power dams with electrically operated locks will completely displace counter-current navigation through open channels and canals along power rivers flowing through regions of vast mineral resources.

Apart by itself, Wilson Dam is not a power-and-navigation unit. It is only the most important factor in the first comprehensive system of river improvement undertaken on the North American continent. This system includes plans for building power and navigation dams for nearly 400 miles up the Tennessee River—throughout the entire distance between Muscle Shoals and Knoxville.

Several of the larger tributaries already are under development by means of very high dams, and Government engineers have just started a regional power-and-mineral survey that will cost $500,000. The cost of the

development itself will run into hundreds of millions of dollars. But whatever financing the Government does on this will be returned to the Government by the companies and corporations that lease and use the power. These staggering expenditures will not come out of the pockets of the people. They will be far more than returned. They will be multiplied by the vast wealth they smelt from the minerals by hydro-power through the electric furnace. And these dams will literally make navigation a perpetual by-product of hydro-power. The significance of this is almost beyond present-day vision.

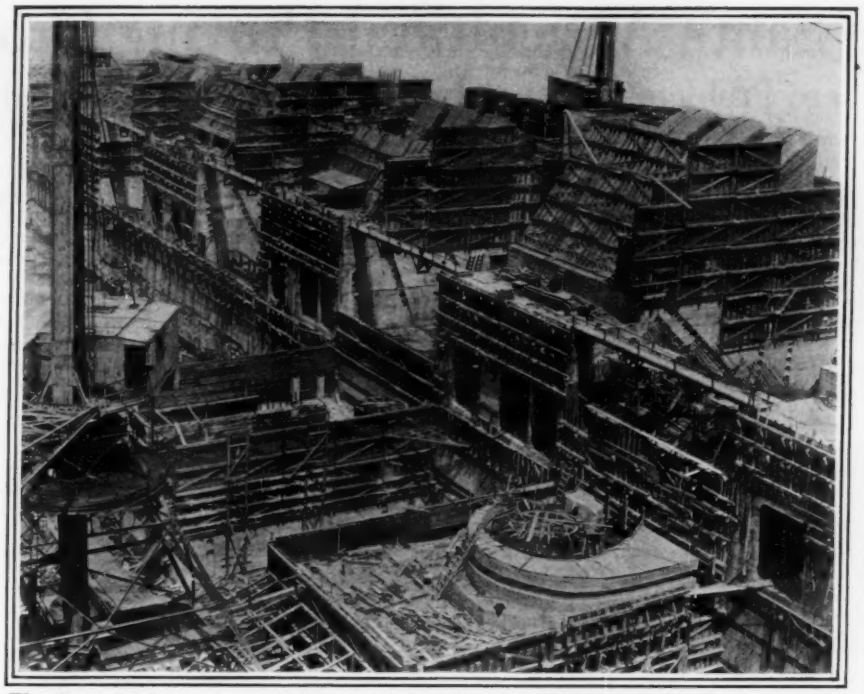
The lower stretches of the development in the Tennessee Basin are fully under way. Between the foot of Muscle Shoals and Chattanooga there will be 11 concrete dams, with locks—three of them power dams. The largest of these, Wilson Dam, is more than half finished. Fifteen miles above—at the termination of the power-and-navigation pool—will be another power generator which will be 40 feet high. Its pool will be 60 miles long.

The next five dams will be for navigation alone and will range in height from eight to eleven feet. Work is in progress on one of these and the survey for another has been made. Then, 33 miles below Chattanooga, is the Hale's Bar power dam that has been in operation for several years.

In the manufacturing field Wilson Dam is highly significant because it is in the midst of one of the richest and most diversified mineral regions in the world. Fifty miles directly north are the second largest phosphate rock deposits in America. Within less than 100 miles south are the Warrior coal fields—the most extensive and productive in the entire South. Both north and south and northeast up the river are brown hematite ores beyond present computation. There is virtually limitless material on which to use the river's power through the electric furnace. And, incidentally, the greatest system of electric furnaces in the world is ready for operation in the huge air-nitrates plant just below Wilson Dam, a description of whose processes appeared in the May issue of this journal.

The variation between the primary and secondary power of Wilson Dam cannot now be determined. It depends upon whether or not storage dams are built to conserve the flood waters of winter for power uses during the summer. It is stated that if the Government leases the project to Mr. Henry Ford, he will build immense storage basins on two tributaries of the Tennessee—the Clinch and Powell rivers. These streams, the contours indicate, can be converted into storage basins by the building on them of very high, but quite narrow, concrete dams.

The next Congress will make final disposition of the Muscle Shoals project and properties; and perhaps quickly. While many ideas have been suggested and advanced, the only definite plan actually before Congress is that of Mr. Ford. It includes returning to the Government, with interest, all the cost of Wilson Dam and the second great power dam 15 miles east; paying the Government $5,000,000 cash in addition and taking over the plants and properties; and agreeing to manufacture complete fertilizers and selling them to the farmers at not more than 8 per cent above the cost of manufacture.

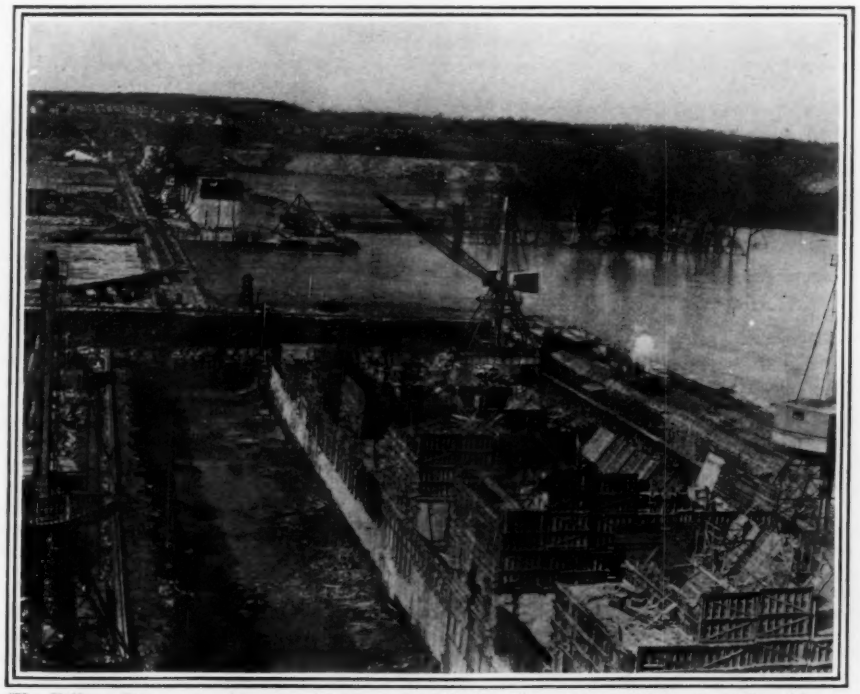


The first of fifty-four penstocks—three to each of the eighteen turbines. One of the huge turbine seats is shown in wood forms at the right

World Metric Standardization

IF we are to believe the very logical arguments of the World Metric Standardization Council as expressed in a rather voluminous work entitled "World Metric Standardization," there exists no good reason at all why the meter-liter-gram system has not been adopted by the people of the United States and Great Britain, except that deep-seated quality of human nature which causes us all to put our backs up and resist changes until they are forced upon us. This book contains over five hundred pages of reasons, both argumentative and testimonial, favoring the adoption of this system, but it would not seem necessary to read beyond the opening chapter in order to become convinced that the arguments are rational, and that the metric system is a sound one and would be a most desirable thing—a generation or two after it had been adopted.

What remains to be done is not so much to convince the average man of its desirability on theoretical grounds, but that he should contribute his share to making the change. This the book attempts to do, and seems to accomplish with conviction. It points out what seems quite possible, namely, that after two or three weeks of attention to the metric system as it would touch us in our daily lives, we should have a good command of it and its arbitrary values. However, the greatest obstacle to overcome is not mental or temperamental, but is inherent in inanimate and tangible things—the things that go to make up our ordered and mechanically dominated lives today such as parts of motor cars and the uniform length of a roll of butter. We live in a mechanical age when everything about us is standardized on a basis, chiefly the duodecimal, that sets the size, weight and volume of things that we use far more often than we realize. It is the transition from the system of machine tools which are set to produce these things, many of which cannot be set otherwise without rebuilding, that bulks large in the mind of the engineering world. But these arguments the book under discussion claims to have refuted. It states that many American manufacturers are using the metric system of measurements today for the production of export articles. They have stated in some cases that the necessary change in standards was effected without annoyance and that the use of the metric system has so greatly reduced certain costs as to more than pay for itself. But in the last analysis the decision of whether the system should be used will depend on the feelings of the individual, and these have not yet been worked around to the point where the average American or Englishman is willing to make the break.



The Wilson Dam powerhouse and the great cofferdam from the south bank, with spillway section in the distance

Ro

RO is a language, but there is no Land of Ro. It is used all over the world, yet the world does not use it. It is a tongue made up out of whole cloth, on a basis of usability. With a knowledge of it the world would become one nation, for language is a barrier that begets many misunderstandings between peoples who have no way to communicate their ideas in a clear manner, fully and completely. If Ro, or any other of the several machine-made tongues, could be "put over" in a day; if we could all go to bed saying "Good Night," or "Bon Soir," or whatever good night is in Swahili; and wake up saying "Good Morning" in Ro—and go on talking it the rest of our lives just as we formerly spoke our own tongue, this would soon be a better world to live in. Or if we could all by some magic be made to talk something like this—"El ye ni cikno uq zad faz ov riceler al kiwap ov temeler ap azod ro"; or if when we miss our train we could make sounds like this, "Uf abz hogem ut muyab el kibeger odj at tecor faz ov ade ragaparz in at boba ov kecab, amit awik ni hab ad kibeg udze in boba ov ro"—if we could utter these noble accents, how much sweeter life would be!

But folks won't. They, including ourselves, prefer to "walk in the ancient ways," as per Confucius.

The fact is, another "Ro" is being built now. We speak it. The world is turning more and more to it as a language of business and commerce: English.

Man has been developing a few hundreds of different tongues since a few hundred thousands of years. It has always been a diverging movement; the tongues have always differentiated. But the age of machinery, with rapid, easy travel, has mixed the world's people. The age of printing and electricity has already mixed our languages. In a real sense this process has been going on but a century, yet already there is a strong converging force in the world's speech. It is coming down before long, comparatively speaking, to one tongue. That tongue will hardly be exactly English, or French—or any other. Rather will it be a mixture. Already there is a vast infiltration of words between the leading European languages; and this process is bound to occur even more extensively in the future. A "struggle for existence" is going on between words, and the "fittest will survive." Nobody will have expended any conscious gray matter over it, or if they do it will have been as vain a thing as the efforts of certain people to guide the course of styles in feminine wear along a rational, predetermined course. There will be a "universal language," not so perfect, not so mathematically constructed as Ro. But it will not be Ro.

Uncle Sam's Agricultural Proving Grounds

The Federal Farms Where Problems of Vital Import to American Agriculture Are Investigated

By Ralph Howard

BELTSVILLE, Md., 14 miles northeast of Washington, is the site of the 475-acre animal husbandry and dairy farm of the Federal Government. It is close enough to the scientific laboratories and offices of the scientists to be readily accessible, while far enough out in the country to be a regular "dirt" farmer's farm managed and operated along practical lines. With its complete equipment and extensive quotas of live stock of the leading breeds and classes, it can undertake investigations which are beyond the compass of the average state agricultural college and experiment station; while still cooperating with the 48 experiment stations so that its findings may be verified in other sections of the country.

The Beltsville Experimental Farm was purchased and established ten years ago when the need for agricultural proving grounds along animal husbandry and dairying lines was keenly evident. The dairy farm of 187 acres has a live stock population of 150 animals of the Holstein, Jersey and Guernsey breeds and is fully equipped and developed as a modern and progressive milk farm. The animal husbandry farm aggregates 288 acres and boasts substantial and serviceable buildings and improvements.

A visit to Beltsville Experimental Farm is as interesting and instructive as attendance at the bonanza state fairs and live stock expositions. Practical investigations of vast economic importance to live stock farmers are constantly in progress at the government farm, and usually so much is going on there that a visitor feels as though he had attended the biggest six-ring circus under the sun. Sheep, hogs, cattle, milch goats, horses and poultry are being raised, fed and studied in large number. The milch goats of the leading breeds are centralized in a milking herd which is maintained under such sanitary and practical conditions in a special stable that milk free of all odor and taint and more palatable and thirst-appeasing even than cow's milk is produced.

The goats are economical producers of milk which is especially well adapted for the feeding of puny infants and invalids. Two milking does can be fed and maintained at less cost than the average family cow and they will produce as much or more milk. In the neighborhood of large cities, there always is opportunity for the establishment of a practical and profitable goat dairy.

Beltsville Farm really is a huge laboratory for the study of the principles and practices of animal breeding. The farm has enough pure-bred Berkshire, Poland China, Duroc, Jersey, Chester White and Tamworth sows so that the spring pig crop usually runs well over 200 head. Enough foundation poultry of the leading breeds is maintained so that the annual crop of chickens is around 5000. The flock of Southdown sheep which is handled strictly on a farm basis is without equal in the United States.

The problem of the eastern and southern farmer often is that of keeping his flock of sheep on a limited area. The government specialists have accomplished some extremely mentionworthy results on one 33-acre field at Beltsville. Four years ago, the stock-carrying capacity of this field was limited to 44 ewes and 33 lambs. At present it supports in contentment and plenty more than 100 ewes and their progeny. Other practical problems of breeding, feeding and sensible management of the flock are constantly under scrutiny and consideration and its activities have been of pronounced profit to sheep raisers, the country over.

The poultry investigations have demonstrated that the utility production of poultry can be combined with standard breeding. All the hens and roosters have been standard-bred since the inception of the flock and no birds are retained for breeding operations which will not qualify under the American standard of perfection. Uncle Sam has established a strain of White Leghorns, the majority of the females of which are producing 200 eggs or better during their pullet year. A majority of the individual males and females in the flock are good enough in form, feather and fitness to win in any show which is held in the United States. Most of the work has been done with White Leghorns and Rhode Island Reds although many specimens of the other leading breeds and classes are also maintained. These birds have been trapnested and therefore pedigreed for four full generations. The Federal poultry experts have also developed a new breed of poultry which is more robust, larger and healthier and which produces as well as the Leghorns—or better. These fowl have been obtained from judicious crossing of the English Dorking, White Leghorn and White Plymouth Rock breeds.

One of the outstanding achievements which has resulted from the swine breeding and feeding investigations at Beltsville has been the practical demonstration of the adaptability and value of fish meal as a protein-rich nutrient for use as a substitute for tankage and blood meal in the porker rations. Government tests at Beltsville showed that there was practically no difference in the feeding value of fish meal and tankage and that the use of the former material in no respect tainted nor flavored the pork. This frees the hog industry from the limitations imposed by the insufficient supply of packing plant tankage, and is therefore of basic importance to the swine-growing industry. Furthermore, it leads to the efficient utilization of millions of tons of low grade and by-product fish available along the Atlantic and Pacific coasts which, heretofore, have gone to waste.

PROBABLY the most of us who are not intimately familiar with the minute ramifications of the national Department of Agriculture visualize this branch of the Government merely as a group of beautiful and ornamental buildings inhabited by expert scientists who are familiar with all the complexities of crop production and animal industry. Such a supposition is all right as far as it goes. But Uncle Sam as a farmer is not content to assimilate all his lore from ponderous tomes and voluminous treatises. He is an active, regular "dirt" farmer who likes to mix things up with the mellow earth and who prefers to learn at firsthand about the idiosyncrasies and peculiarities of his live stock. That is why he maintains the greatest agricultural proving grounds in the whole world—annually productive of facts and figures of immeasurable value to the soil-tilling universe, in general, and to the American farmer and his folks, in particular. This is the story that Mr. Howard tells us here.—THE EDITOR.

The animal husbandry experts ascertained that it cost between one and one-half and five cents more per pound to grow and fatten lousy hogs than it did to develop porkers which were free from such parasites. It is such a simple matter to keep porkers free of blood-sucking pests of this description that the results of this experiment have exerted a beneficial influence on hog management principles from coast to coast.

At this writing the animal husbandry department is beginning investigations of the causes of soft pork. Throughout the southern states hogs are fattened largely on peanuts. However, the exclusive feeding of peanuts results in the manufacture of soft, oily and greasy pork which does not keep well and which is discriminated against in the market. The solution of this problem will be of vital value to the hog growers who live south of the Mason and Dixon line.

Little is done at Beltsville in studying horse and cattle feeding and breeding. Four state cattle stations at Lewisburg, W. Va., Manhattan, Kan., McNeill, Miss., and Jonesboro, Ark., are used as government grounds in their various localities. The work at Manhattan in cooperation with the state experiment station is exceptionally interesting. A herd of Short-horn cattle has been under observation for five years and it is anticipated that it will take about 15 years more of study before the experiments are brought to a definite conclusion. The purpose of the tests is to determine the correlation between the milking function and the production of high quality beef, the effect which the milking tendency of the dam exerts on the male and female progeny and whether it is possible to develop and intensify the milking characters and still maintain in perfection the beef-giving properties.

Along about 1907 when the extinction of the Morgan horse was threatened, the Morgan Horse Farm of Uncle Sam was established at Middlebury, Vt., for the rehabilitation and development of this splendid breed. At this writing, the farm covers 950 acres and has a horse population of 75 excellent animals. This farm has resulted in a new lease of life for the Morgan horse.

At Buffalo, Wyo., is another of Uncle Sam's horse farms where is well under way the breeding of American utility horses—a native breed which the Department of Agriculture is trying to develop in cooperation with the Wyoming Experiment Station. For the most part, standard-bred mares are being used as foundation stock although some saddle, Morgan and thoroughbred blood is also in evidence. The results of these breeding operations indicate that, ultimately, the new and native breed will be permanently fixed in type.

The government sheep farm at DuBois, Idaho, covers 28,000 acres and now numbers over 2000 Rambouillet, Corriedale and Columbia sheep—the latter a new breed created and developed by the Department of Agriculture. By mating the ewes of one generation with rams of the previous generation, without ever reverting to the use of the early foundation blood, the new breed has been permanently established in five years and is the first example of its kind which has been perfected in such a brief period. Also, at the DuBois farm it has been ascertained that under range conditions as much wool is obtained from the breeds of sheep with bare faces as from those bearing wool from their noses to their toes. The sheep with wool on their faces have always been pronounced subject to snow-blindness because the snow and moisture would clog and freeze on their woolly faces.

Extremely valuable work is also being done at Beltsville Farm along the line of animal genetics. At the present time, the investigations have covered 21 generations of guinea pigs with the result that data of immeasurable importance have resulted. It is proposed to continue these experiments, using larger animals more closely related to man and his mates than are the guinea pigs and in this way to check the initial findings.

The Beltsville Dairy Farm is now engaged in one of the most important breeding experiments ever attempted. The purpose is to ascertain how best to develop a strain of cattle which will be uniformly high producers—whether by line breeding or by outcrossing. It is anticipated that it will take from 20 to 25 years to bring this investigation to a conclusion. All the heifers which result from these matings are being kept in the Beltsville herd while some of the male progeny are being loaned to a few of the southern agricultural colleges which are cooperating in the work, which already has run for four years.

Another investigation which promises more efficient feeding methods involves the testing out of various protein feeds to determine which are the most productive of maximum milk flow. Some proteins are more productive of amino-acids than others, with the result that they engender heavier milk yield. The testing of the protein feeds to find out which are the heaviest carriers of amino-acids is bringing to light the materials which are best adapted for use in the cow's daily dietary.

Other tests are being conducted to decide whether it is preferable to milk two or three times daily, whether it pays to water the cows two or three times a day where the animals are stabled, whether the box stall or stanchion system of stabling is most desirable for the valuable pure bred individual, and what mixtures make the best substitute combination to use instead of whole milk in calf-feeding. Valuable results have obtained from the Federal findings that cows must be supplied with mineral salts rich in calcium and phosphorus if they are to maintain their heavy yields of milk.

Recently the cottonseed-oil industry has perfected a new method of extracting oil from cotton seed. The by-product is different from cottonseed meal and cake. The cotton-oil crushers have requested the Department of Agriculture to test out its feeding value, and this is being done at Beltsville Farm. Studies also have been made of the feeding value of different kinds of silage.

In order that the dairy experts may be in intimate touch with commercial dairy projects, Uncle Sam acts as supervising expert for the Grove City, Pa., creamery, which makes all its products and operates its factory according to methods recommended by the government. This permits of trying out under commercial conditions, the methods devised in the laboratory.

In addition to the Beltsville Dairy Farm, the Federal Dairy Division also operates 12 other cooperative dairy farms which range from 200 to 1000 acres in size and which are located all over the dairying country. Arlington Farm—the 400-acre crop and fruit proving grounds of the national government—abuts the Potomac River and at one time was a part of the Park Custis Estate owned by George Washington. Just as Beltsville is without equal throughout the entire world as an animal farm devoted to scientific investigations, so Arlington is without peer as a testing ground for crops, fruits, fertilizers and practically all kinds of plants known to farming science, both in this country and abroad.

The farm consists of two types of soil—a heavy clay which is typical of the Coastal Plains region from Washington to Georgia and an alluvial soil typical of all the leading trucking areas from Long Island to Florida. This means that every crop which can be produced successfully at Arlington Farm can also be grown over the belt under discussion, other conditions being equal. All the foreign forage and cereals as well as fruit crops which have been acclimated to American conditions have been tested out at one time or another at Arlington Farm. The Farm is replete in storage and testing laboratories where conditions in cold storage or other storage can be duplicated. In fact, the financial returns which the sweet potato and trucking industries alone have realized from the Arlington Farm experiments has more than repaid the Government for its establishment and maintenance.

From 600 to 700 varieties of apple trees, 300 varieties of grapes and 400 varieties of peaches are now being tested out. The vegetable trial grounds frequently contain as many as 1200 different varieties while the sweet potato plots not uncommonly are planted to 100 different kinds of yams. The place is so laid out that all the buildings are heated from a central plant while a huge water supply is piped to all parts of the grounds.

Just to illustrate how important it is that the truck farmer use only specially selected seed of the best varieties, the experiences of a Maryland trucking region are illuminative. A storekeeper in this area sold large amounts of tomato seed to the neighboring farmers, accepting the word of the wholesaler from whom he purchased the seed that it was of good quality and adapted to use in the locality. The tomatoes were destined for use in the local cannery. When the plants began to ripen, it was evident that all the tomatoes were yellow instead of red and practically valueless so far as canning operations were concerned. Hence due to the unreliable seed supply the chief cash crop of the entire locality was ruined at a time when red tomatoes of similar size and excellence were selling for $50 a ton. Federal control prevents such catastrophes.

The Bureau of Soils as a result of its experiments at Arlington Farm has recently devised a blast-furnace method of extracting phosphoric acid from phosphate rock so that the product can be bottled and sold commercially to farmers for the tonicking of their phosphorus-depleted soils. This is one of the greatest fertilizer discoveries of the modern era as it eliminates the previous transportation problems which were associated with the shipment of phosphorus in the ground rock form long distances from the mines to the fields.

The investigations of the Bureau of Plant Industry which led to the definite conclusions that plant growth is dependent almost exclusively on the length of daylight to which it is exposed were also performed at Arlington Farm. These investigations have been proclaimed by plant pathologists to be the most important discoveries ever made by the Department of Agriculture.

Uncle Sam's farming scientists are constantly on the hunt for new cereals, forages and grasses adapted to the soils and climatic conditions in this country. As a result they are running trials every growing season of hundreds of crops of overseas origin. Through tests of this description, napier grass, sudan grass, carib grass, Rhodes grass, velvet beans, feterita, hegari, cowpeas and over 1000 different varieties of soy beans have been introduced. In addition, experimental work is perpetually in progress in improving the types of the crops now in general use. The Government experts are always busy with the colossal task of finding new crops which are better adapted than those already in use for culture in certain sections of the country. In this way they introduced alfalfa to the western states, sorghums to the Southwest and the velvet bean to the Gulf Coast states. Despite that the general opinion among laymen is to the effect that all the valuable farm crops worth working with have already been discovered, there are thousands of plants of possible utility as producers of forage which as yet have never been studied.

1. All the goat's milk produced at Beltsville is used in the laboratory production and testing of "foreign" cheeses. 2. Antemorten examination of experimental hogs at the Beltsville farm. 3. The Federal farm at Arlington is the largest of the sort in the world. 4. The Oils and Fats Laboratory of the Department of Agriculture which at present is making a special investigation of cottonseed oil. 5. Dark-house laboratory at Arlington, where is studied the effect of light and dark on plant growth

Glimpses from the United States Government's Experimental Farms in Virginia

Our Point of View

An Editorial Grievance

PSYCHIC research involves two major questions. The first is: do the phenomena of mediumship occur in good faith, without fraud or trickery on the part of the medium? The second arises only after an affirmative answer is given to the first; granted that they do so occur, what is their cause and *modus operandi?*

There is no ground for predicting, *a priori*, that the average mortal would confuse these questions, and be unable to discuss the one without dragging in the other. There is no ground for predicting that, of the numerous answers which might be suggested to the second question, any particular one would occupy such a large place in the public mind as to stand for the whole subject matter of psychic research. Yet both these things have happened, and herein is our grievance alluded to above. With both the written and the spoken word, we have, after persistent effort, signally failed to impress upon our audience:

First, that one can deal with the occurrence of psychic phenomena without at all attacking their cause.

Second, that one can deal with their occurrence, and even come to a conclusion that they do occur, without giving any consideration to the question of individual survival of death, and without saying anything that in the least degree involves this question.

Third, and more specifically, that our own psychic investigation has not so far had anything to do with spirits, spooks, ghosts, or whatever you wish to call them; and that it is entirely possible for us to push it to conclusion without its ever coming to have anything to do with spirits, with spiritism, or with the hypothesis of spirit survival and communication.

As an alternative to the belief that the world is in an incredibly illogical mood, we have examined our own utterances on these points. They seem quite unambiguous—clear enough, beyond all doubt, to dispose of the thought that the rest of the world is sane, while we are unable to put a simple thought in intelligible words. Yet with negligible exceptions, the world goes right on linking us with the spirits, assuming merrily and whole-heartedly that our finding will necessarily be an endorsement or a repudiation of the spirits, that it is the spirits and nothing else that we are investigating.

Nor is this all. We believe we have made it sufficiently clear that the invasion of European psychic centers by one of our staff has no direct connection with our formal investigation here. This member of our staff has, we believe, made it singularly clear that, while it is quite impossible for him to attend seances of such varied character and so rich in incident without bringing away some very definite impressions as to the probabilities of the fraudulent production of what he has seen, these remain impressions of the probabilities and nothing more. Yet he has been widely misrepresented as one who has stolen his Committee's functions, who has demonstrated himself to be a credulous simpleton, and who has stated that what he saw convinced him of the reality of the phenomena.

Again: we have repeatedly pointed out that a fair-minded investigator may form no prejudgment, and have repeatedly set down the necessity for not leaning toward or against the phenomena. And the world goes right on honoring the one-half of this warning in the observance and the other half in the breach—insisting that the investigator must not admit in advance that maybe the phenomena occur, but granting him the privilege of insisting as vehemently as he pleases that they cannot and do not occur. Worse, it goes right on assuming that this is what we mean, and castigating us when we depart from this standard.

Of course the reason for all this is that in the psychic field as in no other, most of us have our own violent preconceived opinions. Any statement read or heard offers two alternatives—to twist it into agreement with these opinions, or to twist it into disagreement and reject it. We should be vastly pleased if the world would overcome its tendency to prejudge this subject. Failing this, we should be almost as well pleased if everybody would believe that, on this subject as on others, we speak after due thought for the form of our utterance, and mean exactly what we say. Much misunderstanding would be avoided if this could be done; for we cannot possibly correct every published misstatement of our attitude, even if we could be sure that all such come to our attention.

Making Airplane Travel Safe

THE DISASTER on the Paris-London Airplane Service, when a machine burst into flames and fell, carrying six people to their death at Monsures, France, was a tragedy which is certain to emphasize in the minds of the public the danger of airplane travel. Nevertheless, we should guard against giving an exaggerated importance to this event by bearing in mind the many millions of miles that have been flown without any fatalities. We must keep our sense of proportion and consider the wonderful record of our aerial postal service and the fact that commercial service has to its credit the fact that one American company in 1922 made over 2000 flights and carried over 9000 passengers without an accident, and that the British service had a record for the same year of 630,000 miles flown without a fatal accident. Also, it will help us to a true judgment of the safety of airplane travel, if we bear in mind that, even today, it is a comparatively new art and that some of its major problems have yet to be solved. They will be solved and travel by air will become as safe as travel by train or ship. Statistics of travel show that the railroad train is so secure that a passenger runs less risk of accident than he does on the streets of any great city. Yet, we must not forget that the toll of injury and death in the days of early railroad development was both large and continuous. Rails would break; the track would spread; broken wheels and broken axles were common; bridges collapsed; and the frequent collisions took a frightful toll of human life.

Again, just at the time when the steamship companies were publishing perfectly correct statistics to show that the risk of travel by sea to the individual passenger had been reduced almost to zero, there came, like a bolt out of the blue, news of the sinking of the world's latest and largest steamship with the loss of some 1500 lives. Yet, large as was the death toll, when it came to be applied to the general average, the risk to the individual was raised but very slightly.

But after all is said and done, it cannot be denied that the problem before the builder is to make the airplane so safe that the passenger will take his seat in a commercial machine with something of that same confidence with which he starts upon a trip by rail or steamship. The growing tendency to use all metal construction augurs well for safe travel in the future. Fire communicating from the engine to the gasoline tank is a terrible danger, but it becomes greatly intensified if the fire takes hold of the combustible material of a wood and fabric machine. Hence we look for all-metal to be recognized as the *sine qua non* of commercial airship construction. The possibility of a back-fire from the engine will always be present with the current type of engine; but something surely can be done to prevent the flame from communicating with the gas tank; and it should be possible to mount the gas tank, so that by the pull of a lever it could be dropped clear of the machine as freely as an airman drops a bomb.

The Flurry Over Naval Gun Elevation

THOSE who read the article by our naval correspondent in London, giving the facts as to the elevation of British guns, will realize how purely artificial and thoroughly misleading was the recent excitement on this subject in our daily press. It was indeed a veritable "tempest in a teapot." Mr. Bywater traces the development of the mounting of naval guns from the days of Nelson to those of the great war, and we learn that, with the exception of the "Hood," the maximum elevation of the guns on the existing battleships was determined before 1914, and that on not a single ship has it been changed since then.

The interest in the subject of extreme range is due to the introduction of airplane spotting. Before 1914, ten to twelve thousand yards was considered to be the extreme range at which engagements would take place. Spotting, or observing the fall of the shots, was done from the fire-control platform at the top of the mast, and beyond those ranges it became increasingly difficult to spot with serviceable accuracy. Hence the use of the airplane, which enables the spotter, looking down from his lofty elevation, to note the fall of the shots and estimate, with accuracy, how far they are over or short of the target, even when the target is hull down and invisible from the firing ship.

Personally we do not believe that in actual battle a judicious Admiral will wish to fire away much of his limited amount of ammunition at ranges, where, even with the assistance of airplane spotting, the chance of landing on the enemy will be small, and surely out of proportion to the amount of ammunition expended.

Let us consider the routine of airplane spotting, say at a range of 30,000 yards, and see what interval of time there is between the fall of one salvo and that of the next, as corrected by the spotter. After seeing the splash, a second or two is consumed by the aviator in determining its position in reference to the target; it takes additional seconds to wireless this "spot" to the ship; a few more seconds to receive the message. Then, in the central station, the corrections must be applied, the change in elevation in guns determined, and this change applied to the sights, before another salvo is let go. Let us suppose that sixty seconds are consumed in all these operations. A salvo at 30,000 yards range will take about sixty-two seconds to reach the target; so that between the time when the enemy ship perceives the fall of one salvo and notes the arrival of the next and corrected salvo, there will be an interval of two minutes and possibly more. If he changes his course as much as four points, or 45 degrees, as the German battleships did frequently in the battle of Jutland, and if his speed is 20 knots, he will have moved his ships some 2800 feet to the right or left of his course before the arrival of the corrected salvo, calculated upon the assumption that he will maintain his original course.

Upon these considerations we base our belief that the distance at which actions can be fought will be determined by the speed of the slowest ship and the range of the lightest guns, and not by the maximum range of individual ships. Beatty had a maximum range, as shown by our table, of nearly 24,000 yards, and, although he had the speed-gage of the enemy, he preferred to open the fight at 16,000 to 18,000 yards.

A Notable Venture in Education

WIDESPREAD attention is being drawn to a system of education, which has been launched by Mr. Arthur E. Morgan, President of Antioch College, whom the readers of the SCIENTIFIC AMERICAN will recognize as the author of the successful flood-control scheme, known as the Miami Conservancy Project in Ohio. In the course of his twenty years' experience as a hydraulic engineer, Mr. Morgan has had in his employ some 2000 graduates of liberal colleges and technical schools, and a close analysis of the failure of many of these young men to make good to the extent to which their education and natural capabilities gave promise, led him to make a broad study of the educational problem. This resulted in what has come to be known as the Antioch Plan, which Dr. Charles W. Eliot has called "the most interesting enterprise in education now going on in our country."

Fundamentally, the experiment that has been carried on at Antioch College for the past two years is the

Our Point of View

latest and most ambitious of those schemes of education which combine with the college course a certain amount of practical outside work in the field, the factory, or the office. But it differs from all its predecessors in the fact that whereas, hitherto, the outside work has been regarded as accessory or supplemental to the classroom, in the Antioch system it is given a position of equal importance, and the time of the student is divided equally between the two. Thus, study at the college and work in factory or office take place in five-week periods; each job being held by a pair of students, who alternate between the study and the shop in five-week shifts.

The fundamental aim is to secure a well-proportioned training, which shall include the development of all the qualities which make for a well-rounded personality, a liberal culture, and a useful knowledge of the conditions in industrial, commercial, or professional work-a-day life. With such an equipment, the Antioch student should fall more quickly into his stride than the young man who on leaving college must adjust himself as best he may, to the untried ways of life in the outside world.

We are all familiar with the age-long controversy as to the respective values—the values expressed in efficiency—of the "college-bred" and the "self-made" man. Antioch aims to send its graduates out into the world, equipped with the culture and mental training of the one and the practical knowledge of men and methods of the other. Obviously, to secure this dual training requires a longer college course than the usual four years; and the course at Antioch calls for forty-five weeks of study and work during each of six successive years.

An incidental but important advantage is the fact that the students become practically self-supporting; the usually haphazard process of "working one's way through college" being changed into a systematic part of education. The more important object, however, is the development, through self-imposed discipline, in real situations, of those qualities which are conspicuous in the "self-made man; qualities such as courage, initiative, the sense of responsibility, and the ability to measure one's powers.

And so it comes that the student has six yearly opportunities to determine, by actual experience, the calling for which he is best fitted.

It is scarcely possible to overstress the importance of that hour when a young college graduate, standing on the threshold of life, has to choose a career. To him the field is all untried; and, except in the case of specialized schools and colleges, or of those who take special courses, the choice is made on no more rational ground than that of the child's "I want to be" an engineer, lawyer or merchant. If the choice should happen to be suitable to his character and capabilities well and good. But if not, one of two things will happen: the young man of courage and resourcefulness will "circulate around" until he finds the work that falls in with his training and capacities; or if, because of an inherent timidity, he is lacking in initiative, he will go to swell that great army of employes in whom a distaste for their work has stifled all active ambition.

The Antioch scheme aims to prevent the occurrence of such tragic failures by launching the graduate upon a carefully-chosen career, enriched with a liberal education, and equipped with several years of practical experience.

Progress in Railroad Electrification

THE APPLICATION of electric traction to the railroads of the United States is proceeding quite closely along the lines which were predicted fifteen or twenty years ago. At that time two ambitious schemes of railroad electrification has been decided upon after thorough investigation of the problem by expert committees, namely, the complete electric operation of the new Grand Central Station, New York, and of a zone of thirty miles of the New York Central's line between New York and Croton on the Hudson. The other project was the electrification of the New Haven line four-track line between New York and New Haven.

The public was quick to realize the grand scale upon which this electrification of the steam railroads of the country was being commenced, and predictions were freely made that, within a decade or so, steam would give way entirely to electricity and the steam locomotive would take its place in historical museums. As usual, the imagination of the public ran far ahead of the facts, and the electrical engineers of the day made haste to explain that, for many years to come, the electrification of the railroad system of the country would be confined to city terminals, to heavy suburban passenger traffic, and to the mountain divisions of the railroads where the grades were heavy and where water-power was available.

The history for the past fifteen years has proved the truth of these predictions; for electrification has been applied on a large scale only to city terminals and suburban service and to the heavy grades of mountain divisions. The latest development of this kind is the decision of the Virginia Railroad to electrify 134 miles of their system lying between Roanoke, Va., and Mullens, W. Va. This stretch includes the mountain division where the line crosses the Allegheny Mountains, and it includes a heavy grade of about 2 per cent over which the coal must be hauled on its way east to tidewater. The Westinghouse Company states that this is the largest single railroad electrification contract which has ever been placed. The great advantage of electric over steam operation on such a stretch of line is shown by the fact that, under existing conditions, three Mallett locomotives are required to haul 5500-ton trains to the eastward, up the 2 per cent grade above mentioned, at a speed of seven miles per hour. The electric locomotives will be able to haul trains of six thousand tons at fourteen miles per hour up the same grade.

Strength of Metals Under High Temperature

THE GREAT advance which has taken place in working steam pressures, with its consequent rise of temperature, renders the question of the strength of metals under high temperature of increasing importance. Furthermore, the gas turbine is now seeking admission into the field of rotary prime movers, and the necessarily high working temperatures of the gas will render still more urgent the problem of providing metals which can be subjected to high temperature without a prohibitive loss of strength.

We have before us a diagram showing the temperature effect on the tensile strength of certain metals, published in the April issue of the *Marine Engineer and Naval Architect*, and compiled from data published by the Directorate of Research of the Air Ministry, which throws valuable light upon this subject. Thus we learn that there is generally a rapid fall in strength with rise of temperature, which is so rapid in bronzes and muntz metals, that the manganese bronze specimen, which had a tensile strength of 41 tons at 100 degrees, fell to 21 tons at 460 degrees and 6½ tons at 750 degrees; while the electro steel test piece fell from 28 tons at 50 degrees to 16½ tons at 850 degrees.

The best results were obtained with a five-per-cent nickel steel, containing 0.005 per cent of carbon, which dropped from a tensile strength of 40 tons at 50 degrees to 39.2 tons at 210 degrees; to 35.2 at 380 degrees, and then rose to 39 tons at 570 degrees. Naturally the behavior of this alloy is variable according to the percentage of nickel employed. Above five per cent the efficiency at first deteriorates; but with as high as 35 per cent nickel a tensile strength of 22 tons per square inch was obtained at a temperature between 900 and 1000 degrees Fahrenheit. The highest strength at the highest temperature was 28 tons at 1300 degrees Fahrenheit: this with a nickel chromium steel.

Excellent results were obtained in the Royal Air Force with the exhaust-gas turbine super-charger for supplying air under pressure to carburetors at high altitudes. Although the Tungsten steel rotors were only a few inches in diameter, they ran with a blade speed of over 800 feet per second in a temperature of about 1200 degrees Fahrenheit. Coming now to the gas turbine, Holzwarth, in describing his gas turbine tests, stated that he used electro steel with a yield point of 13 tons, and a breaking strain of 17 tons, at a temperature of between 800 and 900 degrees Fahrenheit, the strength of his material at 60 degrees Fahrenheit being respectively 23 and 28 tons per square inch.

We must beware of drawing hasty conclusions from the above results. Before they can be considered reliable, the time element must enter into the tests; for we are told that in the case of alloys there has been noted a tendency for the constituent elements to separate out under high temperature of continuous duration.

Seventy-five Years Ago

THE SCIENTIFIC AMERICAN seems to have given as much attention to the sea and ships seventy-five years ago as it does today; but how does this strike you for a prediction: "Perhaps it would not be too much to predict that in fifty years mere sailing vessels will scarcely be known on the Atlantic, and for $50 any citizen will be able to go and visit London and return to New York." A safe prophesy except as to the price.

Another reference which will interest every navigator is the following: "Lieutenant Maury has published some charts of 'Winds & Currents.' He has discovered a region of better winds along the great circle to South America, whereby the passage to Rio, China and all places south of the equator is shortened some ten to fifteen days." Any navigator who sent the track of his vessel with a record of his winds and currents to Washington was supplied with a set of these invaluable charts.

The Coast Survey was doing good work seventy-five years ago in the collection of specimens from soundings. Mention is made of the fact that Professor Agassiz accompanied Captain Davis on his hydrographical work for the Coast Survey, and that he had reaped a rich harvest of discovery, relative to the animals which inhabit different depths of the water.

The Editor grows enthusiastic over the new "Croton Bridge," now known as the "High Bridge," and asks: "What bridge of old can compare with the great Croton Aqueduct Bridge now in the course of erection over the Harlem River in this city? . . . This great work is the more astonishing when we take into consideration that it is a conduit for water brought for a distance of forty miles to supply a city teeming with 400,000 inhabitants." The city government of today understands better the value of art and history and sentiment; for it contemplates throwing this noble bridge into the discard.

Some statistics regarding the English railroads are given, from which we learn that the total length of all roads was 3053 miles. There was an act of Parliament requiring that cheap trains be run to the extent of one daily, carrying passengers at not over a penny a mile at a speed of not less than twelve miles. It was further required "that carriages be provided with seats and protected from the weather."

A letter from R. V. De Witt in our issue of June 17, 1848, refers to a copy of Ramelli's early work on mechanics, etc., which he sold to the Patent Office, with the result that "a number of applications, ready for the seal, were rejected by reason of their exhibition in its pages." Commenting on this letter the editor writes: "This is another nail to the argument for the Smithson fund to publish a work on the progress of inventions. No one would believe, unless he had really experience of the fact, the great amount of time and money expended every year in inventing something old."

Our First Test Seances

The Report of the Sub-Committee and Some Details of the Sittings

By J. Malcolm Bird, Secretary of the Committee of Judges

WHEN I was in Berlin in March, I went through the Grunewald psychic laboratory, which was described in our issue of July, 1922. Herr Grunewald has the finest array of scientific apparatus for testing mediumship to be found anywhere in the world. But after you have seen it all, he sighs gently and expresses a quaint regret that all this equipment has been two years idle. Other investigators have mediums and no laboratory, he complains; he has his laboratory and no medium.

For four months the SCIENTIFIC AMERICAN has been in the same boat. Our psychic investigation has been theoretically under way all this time; but no mediums had come forward to be investigated. The period of watchful waiting was finally broken, with seances by a medium whom we shall designate as Mr. X, on May 21, 22 and 24. We have held this issue from the press in order to include in it an account of what happened.

The seances were held in our library. The table and desk were put out of the way in the corners, leaving ample space in the center of the room. By blanketing the door and the two windows with black muslin, we were able to exclude all light, and get the same brand of total darkness that has already had my testimonial in connection with informal seances. Unbroken rows of shelves line the two long sides of the room. The medium agreed that these were not likely to interfere with the psychic forces.

Sittings were held during the evening hours when downtown New York is inhabited by the cleaning women. Our black hangings and our mysterious noises emanating from a sealed room struck panic into the souls of those stationed on our floor; they were with the utmost difficulty prevented from fleeing the place. The least they looked for, apparently, was a first-class murder with a mangled and bloody corpse.

Permanent sitters were Mr. Walker and Mr. Lescarboura of our staff, with myself; Mr. Owen of the *Times*; Mr. Granville Lehmann of the American Telephone and Telegraph Company; and a friend of the medium from back home whom we may call Mr. Smith. Drs. Carrington and Prince of the Committee of Judges sat on Monday; Dr. Prince and Houdini on Thursday; on Tuesday the Committee was represented by Mr. Frederick Keating, a local conjurer. Other sitters were visitors.

This medium does not go into trance; he occupies a chair in the center of the circle and comports himself quite like the other members of the group. The seance is opened with the Lord's Prayer, after which hymns and familiar songs are sung and conversation carried on, quite as in the usual seance. Mr. Smith leads the prayer, chooses the songs and the moment for singing them, and leads the attack upon them. The medium has an admirable voice, and joins freely in the singing and the talking.

This medium has a wealth of spirit controls—nine, we were told. We heard from Dr. Barnett, a physician and chemist, who speaks in a deep trumpet voice; Bert, an Englishman with a shrill falsetto; Kokum, Hawk Chief, Osecola and a fourth Indian, all rather deep-voiced but quite distinguishable from one another; Mr. Smith's baby boy, who whispers to his daddy; and Christo di Angelo, a singing Italian. The phenomena include these trumpet and independent voices; movements of and tappings upon the trumpet; touching of the sitters with the trumpets and with "materialized hands"; psychic lights; and "psychic" movement of and playing on a guitar.

To get the medium accustomed to the sitters and vice versa, Monday's session was held without test conditions, being quite a duplication of the informal sittings I have held with numerous mediums. The trumpet was supplied by the medium, and left with us until the sittings were over. It carried a luminous band at its larger end; but on Tuesday the medium without previous warning brought in a second, unmarked trumpet. This, too, was left with us until after Thursday's sitting. Both trumpets were quite harmless.

At Monday's sitting the phenomena were very disjointed. We sat for half an hour before I was touched on the chest, apparently by a hand. An interval of ten minutes then ensued before Dr. Barnett announced his presence through the trumpet. Throughout the evening a wait of some minutes thus came between phenomena, and the manifestations themselves were extremely brief. All that occurred came with a suddenness well calculated to startle the sitters into momentary inability to observe closely; and was gone before that ability was regained.

The voices were fairly high in the room, save for Bobby's. Touches came usually on knees or thighs; less often on hands, chest or top of head. Mr. Lescarboura, after the touching began, slipped his chair back out of the circle as far as it would go—about four feet, he thought. He was the last to be touched, but ultimately the toucher found him. When one of the sitters made the observation that all had confessed to a touch save Dr. Prince, Bert's voice piped up: "Dr. Prince has been touched but hasn't admitted it." The Doctor verified this, explaining that he hadn't attached any importance to the touch; any of his neighbors might as well as not have done it. This was the longest speech by any of the voices until the very end, when we were dismissed by Dr. Barnett with a promise of more generous results for the next night.

The Deadly Parallel

THE MEDIUM	THE PHENOMENA
9:36—Out of chair 15 seconds.	Trumpet voice; Houdini touched.
9:37—Out of chair 3 seconds.	Tapping on surface of trumpet.
9:38—Out of chair 12 seconds.	Bird touched, apparently not with trumpet.
9:40—Out of chair 6 seconds.	Bird touched on top of head.
9:42—Out of chair 9 seconds.	No phenomena. Recovering trumpet?
9:43—Out of chair 5 seconds.	Trumpet voice.
9:45—Out of chair for 6, 9 and 5 seconds, in quick succession.	Trumpet voice.
9:53—Momentarily out of chair.	Tapping on trumpet or other object.
9:55—Out of chair 1 second.	No phenomena.
10:00—Out of chair 5 seconds.	Trumpet voice.
10:17—Out of chair 13 seconds.	Houdini touched.
10:21—Out of chair 14 seconds.	Trumpet moving about throughout interval.
10:32—Momentarily out of chair.	Trumpet in motion.

The medium could reach the trumpet without leaving his chair, but with an effort; with it in his hand he could touch all the sitters, without effort. Measurements taken with extreme care Friday morning verified all this. Much of what occurred on Monday would not have called for his leaving the chair; every now and then we got something, especially the voices, which apparently would—this if he were doing it himself, of course. With trifling exceptions, nothing took place at any sitting save when conversation or song were active. The medium and his friend were eager to have me describe the phenomena of other mediums I had seen; more than once such a narrative was broken at the climax by a voice or a touch.

Mr. Walker found himself touched on the hand, and was able to note that the contact was warm, giving the impression of human flesh. When the contacts were cold, they were usually hard enough to suggest the trumpet.

On commencement of Monday's seance, Mr. Smith assured himself that it was thoroughly understood and agreed that no light was to be flashed unexpectedly. Since the medium does not go into trance, nor apparently into any other abnormal or hyper-sensitive state to judge from his conversation during the seance, this seemed extremely suspicious. As always, we were warned not to cross our legs.

Seance etiquette is to greet the spirits when they arrive, and to ascertain from time to time whether they are present. At the present seances this was done with undue frequency and in a curiously uniform fashion. Perhaps fifty times, perhaps a hundred, Mr. Smith exclaimed: "Welcome, friends"—just that; nothing more, and never any variation. In about half the cases the medium remained silent; in the other half he reinforced the query. In doing this, he invariably used the phrase: "Is anybody here?" The multiplicity of control points in the same obvious direction; a question that can mean but one thing with a single control, may acquire nine different meanings when addressable to any one of the nine different "spirits." No attempt was made to de-code any of these, or of numerous other actions on the part of the medium and his friend that might have been signals.

Repeatedly through the seances the medium or his friend would ask for some specific manifestation. They never got it. When the request came from one of the other sitters, however, it was met in a fair percentage of cases. This looked as though it might be an overdone attempt to give the appearance of innocence.

The medium always spoke up from his chair after any phenomenon—not in itself suspicious in view of the fact that he knew he was under test. Sometimes his voice came very quickly after the other voice, the touch, etc.; but there was never absolute coincidence. Particularly, he never attempted to speak from his chair while a voice was actually on. Once several sitters thought that a trace of Bert's falsetto lingered in the medium's remark that followed Bert's.

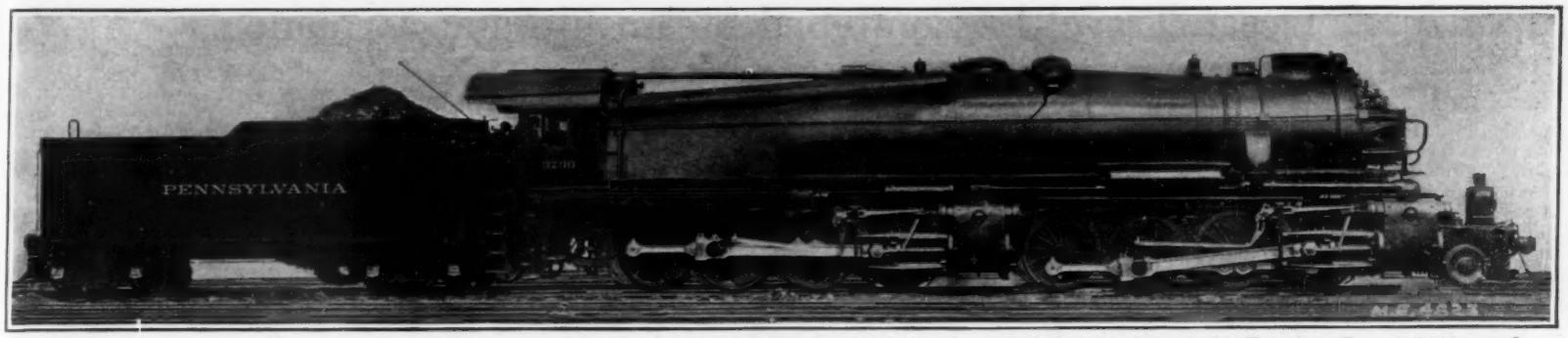
It was understood that controls were to be introduced gradually, and not necessarily with the medium's knowledge, provided they could not harm him. For Tuesday we adopted a device suggested by the make-up of the room. We made several deep and narrow recesses between the books, and in the backs of these, against the wall of the room, we placed luminous-painted buttons. With the room darkened, one sitting directly in line with the narrow channel could see the buttons; moving a few inches out of line obscured them entirely. Buttons were placed in the line of sight from the chairs intended for occupancy by Mr. Lescarboura, Mr. Lehmann and myself. Mr. Smith, however, insisted upon having Mr. Lehmann's intended chair, so this button had to be cut off by a book at the last moment.

Early in Tuesday's sitting there was tapping on the trumpet. We had satisfied ourselves that these taps must be on the base of the trumpet rather than the top, and that the medium would have to leave his seat to produce them if he did not already have the trumpet in his possession. The tapping here was preceded by the passage of an opaque object between me and my range light; ditto with Mr. Lescarboura. Later, when the first of the evening's psychic lights was produced, our buttons were eclipsed before and after the manifestation.

About here it became clear that the spirits had picked me out as the member of the audience whom they must convince, or whom they could most easily hope to convince. For the balance of Tuesday and throughout the Thursday sitting I was the center of everything that happened. Nothing notable would occur save when I was engrossed in song or story; most of what happened was actually directed at me. So I gave my entire attention to cooperating with the spirits, and left the burden of observation from our side of the room upon Mr. Lescarboura's shoulders. He sat there, apparently, like a bump on a log, saying nothing—but taking everything in. Perhaps he would not have looked so harmless if the medium had known that he was the designer of all the electrical apparatus employed, and of the luminous-button control as well.

After he got the hang of the thing, Mr. Lescarboura could predict with certainty when and where something was going to happen, by watching for his button to be eclipsed. Sometimes two eclipses came in rapid succession, indicating a quick trip out and back; sometimes they would be separated by an interval of seconds, indicating that the spook had real business to transact before he could return to the medium's chair. Always they went thus in pairs; always the failure of the second to follow right upon the first marked a

(Continued on page 56)



Mallett mountain freight locomotive for freight service of the Pennsylvania Railroad. Weight, engine and tender, 794,000 pounds. Tractive effort, 135,000 pounds

Three Notable Locomotives Which Mark the Trend of Railroading

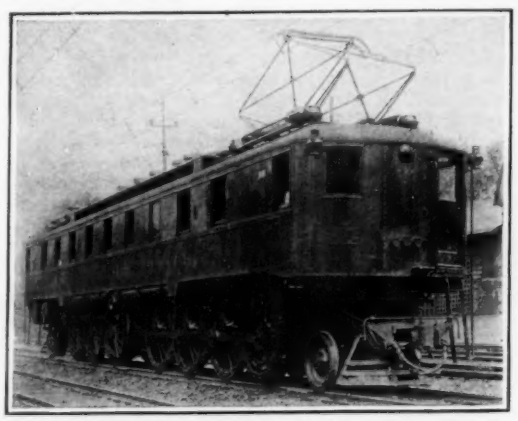
WE present illustrations of three locomotives, one passenger, and two freight, which may be taken as representing up-to-date practice in locomotive design and construction. Each is designed to meet special requirements of certain parts of the line of the railroad systems for which they have been built, and in each the object has been to secure the maximum amount of hauling power, compatible with the limitations of weight upon track, bridges and other structures of the particular systems concerned.

Among the latest achievements in locomotive development is the Mountain Type locomotive for handling heavy passenger trains, recently designed at Omaha, Neb., by the Union Pacific System. This locomotive has the slightest weight per horsepower of any as yet built in this country, which is 98.57 pounds per indicated horsepower. The reduction of weight has been secured by careful design combined with the use of high-grade material, including carbon-vanadium steel for the main and side rods. An ample factor of safety is provided, with unnecessary deadweight eliminated. An order for 55 of these locomotives has recently been completed by the American Locomotive Company for the Union Pacific System.

An indicated horsepower of 3500 has been developed at 50 miles per hour, which is a higher rating than is obtained by the Cole formula. Practically a 100 per cent boiler is provided, and no difficulty is found in maintaining the required steam pressure. Firing facilities are provided by the application of a mechanical stoker, and a power reverse gear, operated by compressed air, is used. The tender of the cylindrical type has a capacity of 12,000 gallons of water and 20 tons of coal, and is mounted on six-wheel trucks. The Schmidt superheater is employed. The principal data are given in the following table.

Length over couplers	90′ 6⅜″
Cylinders	29″ dia. x 28″ stroke
Diameter of drivers	73″
Weight on drivers	230,200 lbs.
Total weight of engine and tender	582,000 lbs.
Tractive power	54,838 lbs.
Total heating surface	6827 sq. ft.

The majority of these engines will be used between Cheyenne, Wyoming, and Ogden, Utah, a distance of 484 miles, where heavy grades are encountered. Thus for the first 31 miles out of Cheyenne there is a steady grade with a total elevation of nearly 2000 feet, and about 10 miles of 1.55 per cent ruling grade. There is also a considerable mileage of 1.14 per cent ruling grade eastbound out of Ogden. In designing a single, powerful locomotive to obviate the necessity for using double headers, it was decided to build it for fast running on level or down-grade sections of the line, and capable of fairly high speed on long stretches of 0.82 per cent grades when hauling heavy trains. In service, one of these locomotives can haul 816 tons at a speed of 50 miles an hour on a grade of 0.82 per cent, the locomotive developing an indicated horsepower of 3500, which gives the rate of 98.57 pounds per cylinder horsepower as noted above. At a speed of 70 to 75 miles per hour, the careful counter-balancing was shown in the smooth riding qualities even at that high speed.



Electric locomotive, mountain division, Pennsylvania Railroad. Weight, 240 tons. Tractive effort, 87,200 pounds

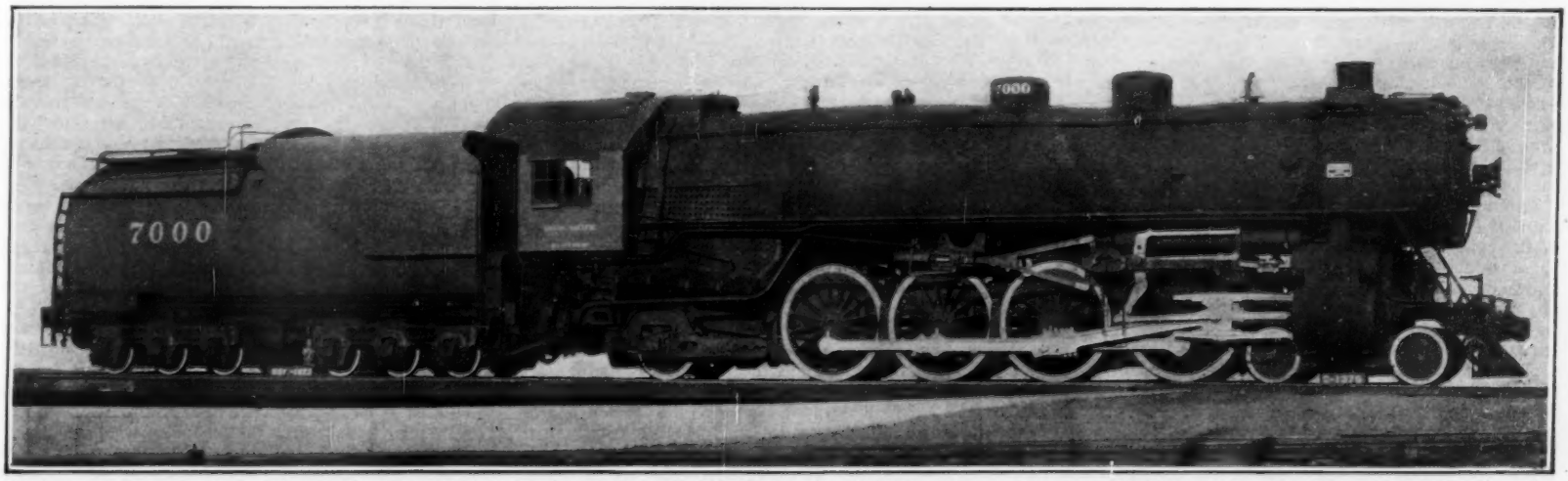
The imposing Mallett freight locomotive, which we illustrate, may be considered to be the most powerful in existence today. It is true that some locomotives, such as the Virginian, are larger and heavier, have a greater starting power in getting a heavy train in movement, but in the opinion of the officials of the Pennsylvania Railroad Company who designed and built it, this engine will evaporate more water and deliver more horsepower than any locomotive of which they have knowledge. We think that the claim is fairly established.

The locomotive is carried by eight pairs of driving wheels, and two wheel trucks under the front frame. The driving wheels are grouped in two sets of four pairs each, and they are 62 inches in diameter. The total load on these drivers is 540,000 pounds, and the total weight of the locomotive is 575,000 pounds. Adding the weight of the tender, we get a total weight of 794,000 pounds. The maximum tractive effort is 135,000 pounds. The boiler is of the Belpaire type, and the barrel has an average diameter of 103 inches. The fire-box is 168 inches in length by 96 inches in width, and the total evaporating surface is 6656 square feet.

The locomotive is driven by two sets of simple cylinders of 30½ inches diameter and 32-inch stroke; thus, departing from the usual practice in Mallett compound locomotive design; but a power roughly equivalent to that of compound locomotives is obtained by the use of a 50 per cent maximum cut-off, with a valve of unusually long stroke giving a quick release. This half-stroke cut-off has a decided advantage in point of steam consumption over a simple locomotive, having a cut-off varying from 90 to 25 per cent of the stroke, in which there is excessive cylinder condensation. The boiler pressure is 225 pounds per square inch. The front and rear engine frames are articulated for passing around curves by bolting steel castings between them, forming a jaw opening connected by a 6-inch pin. This device, operating in connection with powerful central springs, and thoroughly lubricated sliding surfaces, enables the entire front engine to move laterally about its articulation with the rear engine when passing around curves of 400 feet radius. It should be stated that the locomotive is fired by a duplex stoker, and that the grades are operated by a Franklin steam grate shaker. The tender has a capacity of 14 tons of coal and 12,900 gallons of water.

We present also an illustration of an electric locomotive, designed and built at the Altoona shops of the Pennsylvania Railroad. This locomotive was built for test purposes, in connection with the decision of the company to electrify that portion of its mountain line traversing the summit of the Allegheny Mountains. The locomotive is now being experimentally tested on that part of the line which has already been electrified between Philadelphia and Paoli. The principal characteristics of this locomotive are as follows:

Overall length	76′ 6¼″
Total wheelbase	63′ 11″
Diameter of driving wheels	72″
Diameter of pony wheels	36″
Weight on drivers	196 tons
Number of driving axles	6
Total weight of locomotive	240 tons
Tractive effort	87,200 pounds



High-speed, heavy passenger locomotive for mountain grades of Union Pacific Railroad. Weight, engine and tender, 582,000 pounds. Tractive effort, 54,838 pounds

Ocean Travel by Combined Steamship and Airplane

HOW would you like to cross to Europe in a 25,000-ton, 24-knot ocean liner, whose uppermost deck consisted of a platform 100 feet in width, and over 550 feet in length, which was absolutely free from any obstruction in the way of masts, smoke stacks, boats or other marine impedimenta? A promenade, such as that, would be welcomed by those voyagers who like to continue at sea the exercises and out-door recreations to which they are accustomed ashore; to say nothing of those who delight to enjoy a sun-bath, while the ocean winds have free play upon them.

Now the remarkable ship, shown in our opening-page drawing, provides just such a promenade. It is able to do this, because it has been designed jointly as an ocean liner and an airplane-carrier. That the plan is a practical one, is to be presumed from the fact that its designers are Sir Eustace D'Eyncourt and John H. Narbeth, the former being the chief constructor of the British Navy, who is responsible for the latest ships of the British Fleet including the battle cruiser "Hood."

Our drawings, which are based upon a paper presented by the above named at the March meeting of the Institution of Naval Architects, will serve, in connection with the following digest of the paper, to make clear the purpose and main features of this remarkable design. The experience gained by the naval aircraft-carriers, has proved that flying on to and off from ships at sea is rapidly becoming thoroughly practicable, "some 600 successful flights on to 'H. M. Argus' and 'Eagle' have already been made, under varying conditions of weather at sea."

The paper goes on to suggest, that we are now advancing to a position where the aircraft-carrier will become relatively quite an important ship for the Mercantile Marine, and that ship-owners, when that happens, will be prepared to adopt a new type of vessel of this class for commercial purposes.

So far back as the air conference of 1920, it was suggested, that it might be practicable to carry aircraft on mail steamers, and the subject was also approached from the standpoint of a supplementary naval service; an outline design having been prepared at that time for an aircraft-carrying mail steamer. The plans herewith presented, represent the result of further investigation, since that date. This design, it should be understood, is to be regarded not as a supplement to the naval service, but as a special development of the Mercantile Marine. As a matter of fact, the proposed vessel, besides providing all the facilities of a mobile airdrome, will afford ample deck space for accommodations of all kinds, and particularly an enormous open upper deck available for recreation, besides large protected areas on the next deck beneath it. Although the ship is much smaller than the "Mauretania," the cabin accommodation is about 80 per cent of that for the "Mauretania's" for first and second class and 40 per cent for third class.

The idea of the airplane serving as handmaid for the merchant ships, has already been developed. Passengers occasionally leave London, or Paris, by airplane, after the mail train has started, and catch the boat at the English Channel port with a considerable saving of time. This advantage will ultimately be increased; for the airplane, instead of alighting on a land airdrome, could fly right on to the ship herself after she had left her pier. Should this be practicable, flying on and off ships at sea opens up great possibilities for air and steamer service.

Referring to the drawings, the upper or flight-deck, which is entirely free from obstruction, finishes off practically square at a position 100 feet aft from the bow. There is a foremast to carry the navigation lights; also several derricks for the hoisting of cargo, aircraft, stores, etc. Machines rise so rapidly from the deck, and so soon become manœuverable, that the presence of this forward mast would not be objectionable to airmen. The deck below is more or less open to permit some flow of air along the underside of the flight deck, thereby assisting to give a uniform flow of air above the flight deck. At the forward end of the deck is the navigation bridge with officers' quarters. Astern of these is a block of twelve life-boats, a lift serving the forward hangar; and then a second set of 12 lifeboats and hangar similar to that described above.

The deck below, which runs right up to the bow, is the first cabin deck and the accommodations include everything in the way of saloons, writing rooms, and smoking rooms, which characterize up-to-date ocean liners. It will be noticed, from the cross section, that the ship is provided with bulges. Its least width is 85 feet at the water line, from which the topsides flare outwardly to the upper deck. The adoption of bulges enables a very broad vessel to be built, without involving that excessive initial stability, which causes quick and jerky rolling. As a matter of fact, the bulges and the bilge keels will assist to make the ship very steady at sea.

The number of aircraft which can be carried will, of course, depend upon their type and construction; but it will be possible to carry in the two hangars a total of 18 to 20 fast two-seater machines, or a smaller number of large 6 to 10-seater craft.

Now, the advantages of the proposed type of vessel will be understood, from a study of the accompanying map of the Atlantic and of the Mediterranean. These are stated by the authors of the paper, as follows:

(A.) Vessels running on such a service from Great Britain to New York, could send off airplanes which would reach Montreal before the steamer could get to New York. A corresponding gain would be made by Canadian steamers using the port of Halifax; on approaching Halifax, the airplane could depart before the steamer reached the port, and vice versa.

(B.) Vessels sailing between Great Britain and Australia. These vessels would run to Port Said without a stop, and on their route, could serve Lisbon, Gibraltar, Algiers, Malta and Naples by airplane. They would then run from Suez to Colombo and deal with mails for Port Sudan, Khartoun, Aden, Somaliland and possibly Bombay, while on the run from Colombo to Sydney, various other aerial services could be maintained.

(C.) Vessels running from Vancouver, Seattle, Portland or San Francisco, to Hongkong or Australia, could in the same way deal with Pacific islands and ports intermediate between those points.

Are Most Animals Color Blind?

AUTHORITIES call attention to the fact that many persons are color-blind, perceiving colors only in the form of varying degrees of brightness. Some have been led to believe that the same thing is true in many cases in the animal world. This variation of the intensity in light causes a corresponding reflex action in the pupil of the eye.

It has also been found that apes see color practically in the same manner as human beings; dogs, cats and guinea pigs perceive colors but they are more shadowed with grey; doves and domestic fowls see red, yellow, and green just as we ourselves do, but are comparatively blind to blue. The experiments with the pupilloscope were confirmed by others such as the visibility or invisibility of food of different colors. Among invertebrate animals it was found that only the octopus possesses a pupil which reacts to light, and one authority, Carl von Hess of Munich, states that experiments with the pupilloscope indicated a most surprising correspondence of behavior between the pupil of this creature and that of color-blind persons. The instrument could not be used to examine certain other invertebrates and fishes because of their possession of compound eyes; *e. g.*, both insects and crabs have eyes of an essentially different structure which usually do not possess a pupil. In such cases other experiments are employed. The experimenter found that many crabs, caterpillars and fish constantly seek the brightest portion of their containers and show themselves sensitive to the faintest degree of light perceptible to an ordinary eye. On the other hand, some of the invertebrates seek the darkest part of their containers, while many ship worms retreat with lightning like speed at the least decrease of light, such as that occasioned by a passing shadow.

Experiments with about a hundred different kinds of animals convinced Mr. von Hess that the general belief of the existence of a color sense in fishes, and invertebrate animals is entirely without foundation. He remarks further: "It was long ago observed that ants and certain crabs exhibit reactions to ultra-violet rays imperceptible to our own senses. . . . Very recent experiments show that many insects are surprisingly sensitive to these rays. Bees, for example, whose habit it is always to go toward the light turn without exception toward a field rich in ultra violet rays. . . . This may explain why bees, crabs, caterpillars, etc., seem to prefer a given color in spite of being color-blind—the reason is that the said color is rich in ultra violet rays."

These new ideas are highly significant, of course, with respect to Darwin's theory of the effect exerted by bright colors in plants and animals, especially his theory of the part played in sexual selection, as when we speak of the nuptial garments of certain fishes and birds as means of attraction for the opposite sex. Mr. von Hess remarks that these theories can be accepted only when three preliminary conditions are fulfilled, saying: "In the first place the mixture of rays coming from the colored organism must have the same composition as that in which they strike our own retina. Second the nervous apparatus of the animal's eye must be similar to that of the middle portion of the retina of a normal person, since this is the only part which is sensitive to color. Thirdly, we must assume the animal to possess a certain amount of aesthetic sense enabling it to exhibit a preference for one color rather than another.

Mr. von Hess also called special attention in the case of fishes to the difference in color produced by the depth of the water, saying: "Water is never entirely colorless but usually possesses a greenish blue or blue tone even at depths of a few meters; hence the red and yellow rays of sunlight are almost entirely absorbed by it. Therefore when a fish which exhibits bright colors on land lives at a depth of 60 meters beneath the surface, as actually happens in certain cases, even an eye capable of perceiving color could not perceive the red tones which the fish shows upon its sides when brought to the surface. . . . Again, certain creatures living more than a thousand meters under water are most splendidly colored, though at this depth not the faintest ray of light is visible; in such cases, therefore, the theory that these colors are intended either for adornment or for warning is entirely excluded. One can easily get an idea of the transformation of color even a few meters beneath the surface of the water by looking through dark green glasses: red, yellowish red, and yellow will appear dark grey, almost black, and since these are the very colors conspicuous in the so-called nuptial coloring it is obvious that this theory of sexual attraction through color is inadmissible in all such cases."

As far as humans are concerned, observation shows that out of 100 men 96 agree in identifying or in discriminating colors, while the remaining four show defective appreciation. These latter are color-blind. This defect is about ten times less frequent in women. Color-blindness is congenital and incurable, and it is due to an unknown condition of the retina or nerve centers, or both, and must be distinguished from transient color-blindness. Fortunately, in the human it is quite abnormal, and on no such basis of frequent occurrence as appears to be the case with animals.

Reclamation of Used Lubricating Oils

A LARGE amount of lubricating oil for automobiles is now thrown away through the mistaken idea that it is not fit for further use, when the only trouble with it is that it is contaminated with dirt or diluted with gasoline.

For some time past, the Bureau of Standards has been investigating this problem and has found that by using a simple apparatus now commercially available it is possible to reclaim used crankcase oil rendering it in practically every respect as good as new.

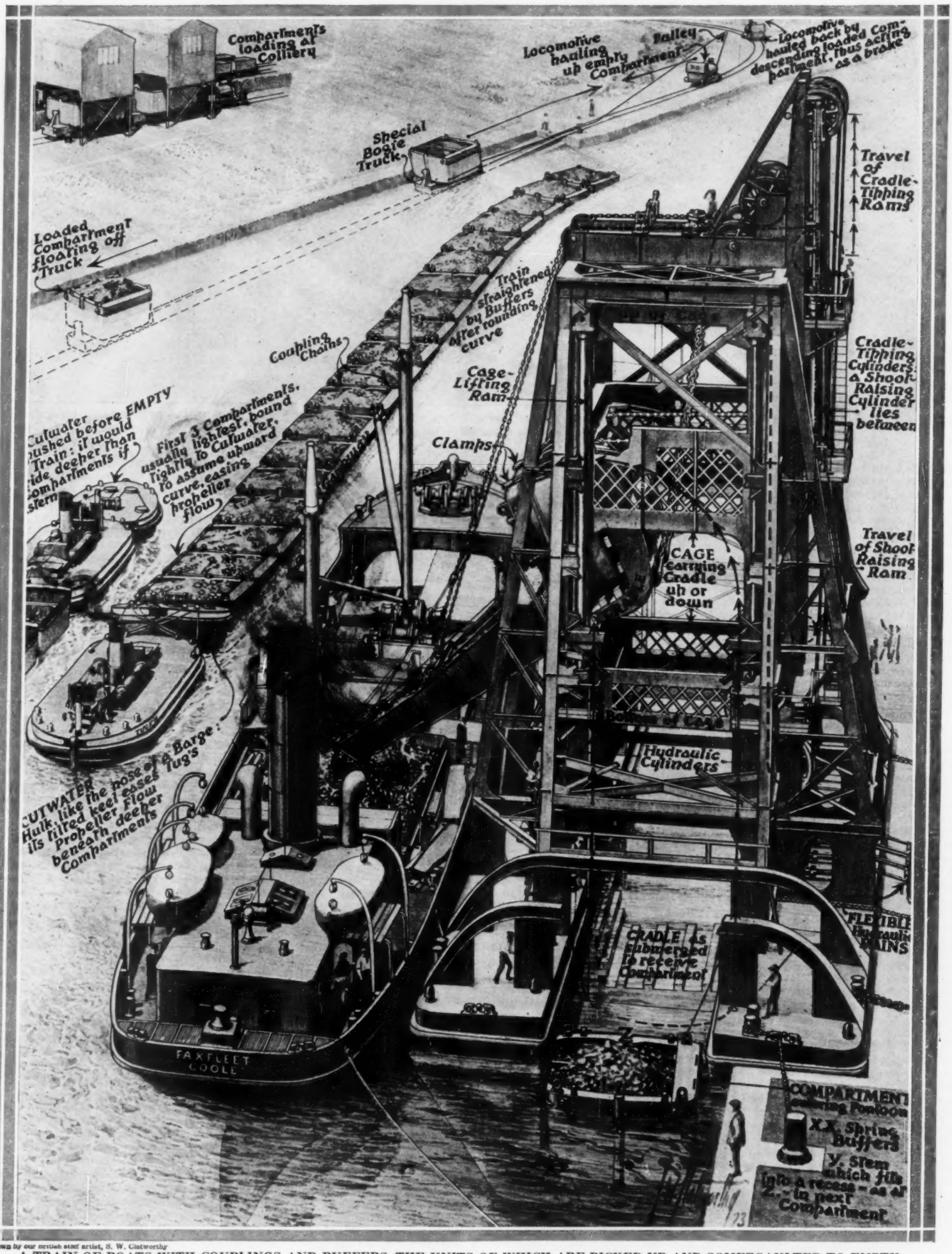
This work is described in Technologic Paper No. 223 of the Bureau of Standards which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents per copy.

Acrobatic Boats for the Handling of Coal

IN a recent lecture before the Institute of Transport in Great Britain, Mr. W. H. French described the remarkable system now in use upon the Aire and Calder Navigation Canal—a waterway which dates back to 1698—for the transport of coal from the Yorkshire collieries to the port of Goole. What are literally "boat trains," comprising up to 20 "compartments" and totaling 800 tons of coal, as depicted in the drawing on the facing page, are used, the entire 450-foot train being passed through each lock unbroken, at one "pen" or lockage. Near the colliery, which is shown in the upper left-hand corner of our drawing, the empty compartments are hauled from the water on a rail truck, the coal being dumped at the colliery screens directly into each, and the filled units then re-launched and marshalled into trains.

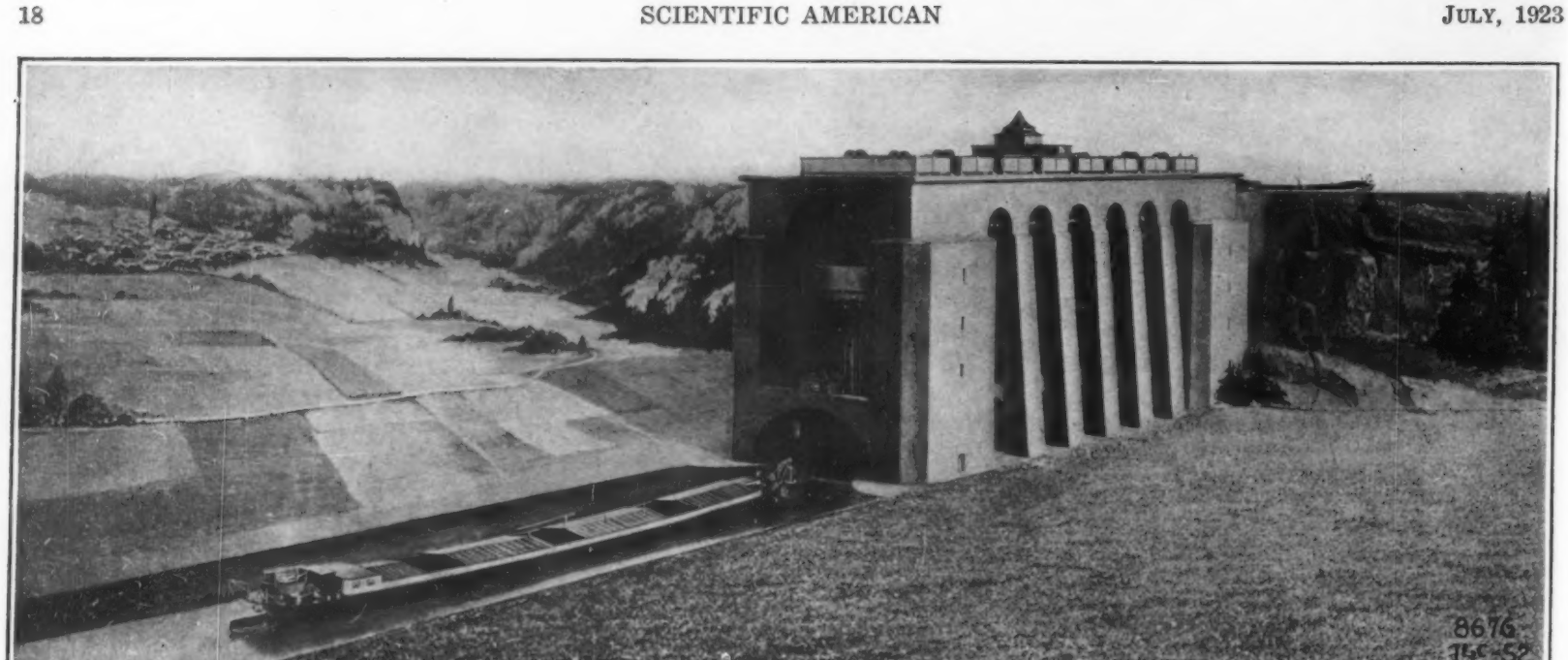
Arrived at Goole, shown in the foreground, each compartment in turn is shunted by the tug beneath a hydraulic hoist, which lifts and tips each compartment directly into the waiting vessel. Each compartment weighs 52 tons. If the collier is of the self-trimming type, the rate of loading is 400 tons per hour.

This train system, the invention of the late engineer, Mr. W. H. Bartholomew, has handled 3,000,000 tons in one year.



Drawn by our British staff artist, S. W. Chitworthy

A TRAIN OF BOATS WITH COUPLINGS AND BUFFERS, THE UNITS OF WHICH ARE PICKED UP AND SOMERSAULTED TO EMPTY THEIR CONTENTS.—(See facing page for description.)



Counterweighted lift lock for a lift of 120 feet, as proposed for the Rhine-Danube Canal, showing the plateau of the Alb which has to be crossed for a distance of fourteen miles at an elevation of 1830 feet

When the Canal Barge Takes the Elevator

THE lift lock is one in which a huge tank, capable of receiving the vessel to be raised, takes the place of the usual stationary lock of masonry. The type is especially useful in locations where, as in the German lock here shown, a steep bluff or cliff calls for a single lift of great height.

In this design the tank and its contents are counterweighted, making necessary a massive supporting structure. Both ends of the trough and of the canal reaches are closed by double-walled gates, which provide security in case of damage to either inner or outer walls. The gates are raised by electrically-operated winches, which are so interlocked with the main winding gear, that the trough cannot be moved while the gates are open, and neither the trough nor the reaches can be opened unless the trough is in an end position and properly aligned with them.

The weight of the trough and contents is balanced by a series of counterweights, arranged in groups and suspended by wire ropes. As these weights are independent of each other, each rope has to carry only the assigned load. A frame surrounding each group of weights prevents the fall of any weight. If one rope should part the load of its counterweight would be distributed evenly among the remaining ropes. A single locking requires about 17 minutes, ascent and descent require about the same interval. Owing to the counterweights, power is required only to overcome starting inertia and friction.

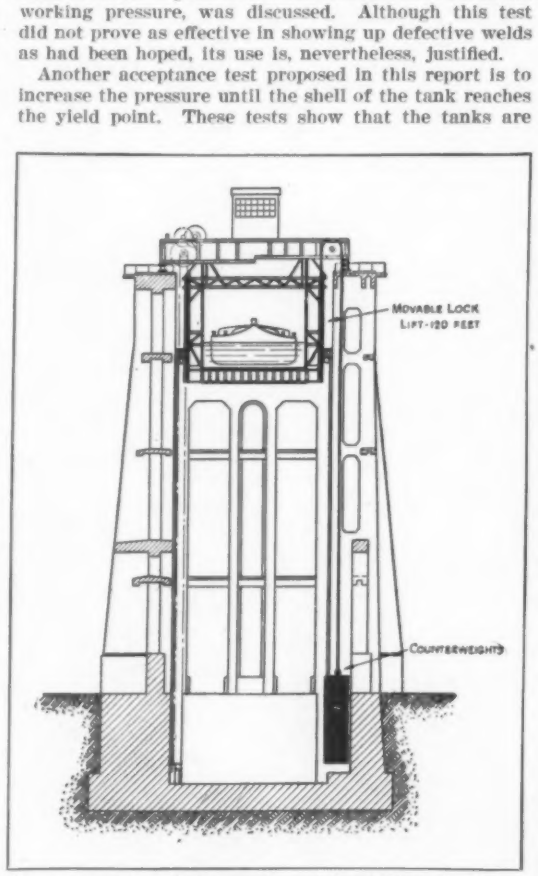
We are indebted to Demag of Duisburg and three associated German firms, the joint designers of the locks, for the illustrations, who emphasize the fact that a distinctive feature of the design is the handling of heavy loads by subdividing them and distributing them over a large number of comparatively small carrying elements. In this way details are kept within limits that have already been proved adequate and safe in actual practice; and any damaged element may be replaced quickly without disturbing the operation of the entire installation, which has been made the subject of our present cover illustration.

Tests of Welded Tanks

THE investigation of the strength of about 50 tanks, some of which had been welded by gas and some by electricity, has been completed. This work, which was carried out in cooperation with the American Bureau of Welding, was begun on December 4 and completed on February 9, and gives reliable information on the strength of welded tanks for the consideration of the Pressure Vessel Committee of the Boiler Code Committee of the American Society of Mechanical Engineers.

The results showed that double-V longitudinal welded seams are much stronger and more reliable than single-V welds. Recommendations were also made covering the design and construction of the heads. The pressures at which these tanks failed were so high that confidence in the safety of welded tanks, which are properly constructed, has been greatly increased. The method of testing, by hammering the weld while the tank is under a pressure of one and one-half times the working pressure, was discussed. Although this test did not prove as effective in showing up defective welds as had been hoped, its use is, nevertheless, justified.

Another acceptance test proposed in this report is to increase the pressure until the shell of the tank reaches the yield point. These tests show that the tanks are



Front elevation of the counterweighted lift lock, showing the operating principle

safe after being tested in this way. As it is probable that tanks having large outlets would be seriously deformed and, therefore, rendered unserviceable, this test is not likely to be adopted, but an increase in the test pressure will probably result.

It is especially commendable to note that the Bureau of Welding, which represents one of the youngest of the engineering industries, has a large number of important problems which it expects to solve. Their importance will be realized when it is considered that they effect almost every one because of the waste of material which results when designs are based on insufficient data or are influenced by prejudice, according to the Information Section of the Bureau of Standards.

Sir James Dewar

SIR JAMES DEWAR, whose death was recently announced, is popularly known to the world as the inventor of the thermos bottle. However, he was not consciously working for what is thus known, but rather for something to preserve liquid gases, with which he was experimenting. The use that his "Dewar tube" is now mostly put to came as an afterthought, not so much of his own but of the commercial world. It is true, however, that Dewar used his invention himself for such purposes, but had no intention of commercializing it. He was later able to liquefy hydrogen and he froze it at minus 438 degrees Fahrenheit. He also isolated hydrogen, helium and neon from the air. He was also the joint inventor of cordite. He died at the age of 81 years.

Spontaneous Changes in Balances

THE Bureau of Standards has just completed a careful comparison of the results of successive tests carried out on two of its highest grade analytical balances. These balances have been used constantly but with extreme care for some years. Both balances showed appreciable changes in the ratio of the arms of the beam which could not be explained as the result of wear of the knife edges. The Bureau considers that these alterations are the effect of spontaneous changes in the beam, probably caused by the gradual release of stresses set up during the manufacture of the balance. This study corroborates evidence of such changes noted in many balances of this type and supports the long-established policy of recommending that analytical and similar balances be checked occasionally by the users.

Spectrophotoelectrical Sensitivity of Argentite

SCIENTIFIC Paper No. 446 of the Bureau of Standards deals with the above subject. It may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents a copy.

Substances which decrease in electrical resistance when exposed to light are said to be photoelectrically sensitive. Selenium is the most commonly known substance having this property.

The underlying cause of this phenomenon is not understood, although by some it is thought that this change in resistance may be caused by a change in the form of the crystal when exposed to light.

Silver sulfide possesses the property of crystallizing in two mineral formations: *argentite*, in which the three crystallographic axes are all equal, and *acanthite*, in which the axes are of unequal length, and, therefore, furnishes a ready means to study the effect of crystal structure upon photoelectrical sensitivity.

The results described in this paper are instructive in showing that the form of the crystal affects the resistance change, but it is not the underlying cause of photoelectrical sensitivity, which is connected with a grouping of atoms in the molecule. This is brought out more clearly in Scientific Paper No. 451.

Our Psychic Investigation in Europe—III

Some Details of a Very Noisy Evening with a Private Psychic Circle in London

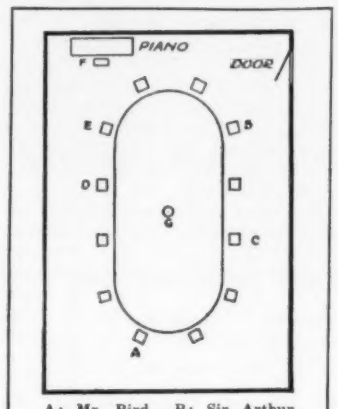
By J. Malcolm Bird

Associate Editor, SCIENTIFIC AMERICAN, and Secretary of the SCIENTIFIC AMERICAN Psychic Investigation Committee

FOLLOWING a week-end at Crowborough with Sir Arthur, came a seance on the evening of March 5, which in some respects was the most remarkable of my entire trip. I shall describe the events of this sitting first, reserving comment for the end. Also, without in any way committing myself, I shall use the very convenient vocabulary of the seance room.

The group is a private one, which has been sitting once a week for seven years. Outsiders are not ordinarily admitted, but Sir Arthur's influence opened the door to himself and his friend from America. The gathering place was the dining room of the quarters above a tiny grocery store on the outskirts of London. The extension table and a piano were the only furniture of note aside from the chairs.

Sir Arthur and I arrived last; with our coming, the proprietor put up his shutters and escorted us upstairs. Of the 13 sitters, one remained outside at the piano while the other 12 formed the conventional circle about the table, with hands joined throughout. There was no medium in the usual sense; nobody went into trance, or stood out otherwise above the general level, save that most of the talking with the controls was done by the proprietor. Two of the regulars had to have certain fixed places at the table, and two others had to be opposite one another. We finally got located in a manner meeting these requirements, and preserving so far as possible the alternation of sex. But as soon as complete darkness was attained, the control demanded that Sir Arthur change his seat. I was not certain whether a simple interchange were effected, or whether several sitters shifted one place each, so as to occupy Sir Arthur's original chair and leave another vacant for him.



A: Mr. Bird. B: Sir Arthur Conan Doyle, after the rearrangement. C: The proprietor of the premises. D: The young lady who laid herself open to suspicion in connection with the movement of the circular plate. E (or D): Sir Arthur's original seat. F: The pianist. G: The circular plate, etc., in the center of the table

The arrangement of sitters and furniture

During the interval between the settling into place and the turning down of the gas I was able to take stock. Regular readers of the SCIENTIFIC AMERICAN will recall, some time ago, a full page of pictures showing the noise-making paraphernalia of stage and screen. Glancing about the table I could think only of this. There was a most amazing array of apparatus scattered about, and clearly we were to have a noisy evening. Two tin-horn "trumpets"; a small and a large bell of the type that is rung by shaking in the hand; a mandolin; a drum, one head being of membrane and the other of tin; drumsticks; a good-sized wooden mallet; a rather large four-legged stool; a wooden whistle; a thick pad of paper and a couple of prodigious pencils—caricatures upon pencils; an electric lamp assembled with its battery in a small wooden case, with red cloth stretched over its eye; a small slate, phosphorescent-painted on one side—this was all on top of the table. Underneath on the floor stood a music box; and suspended in a loose loop from the leg of the table to a point on the under side of the table-top was a strip of leather carrying a string of sleighbells.

As we took our seats in the full gas-light the sleighbells rang loudly. Hymns were sung to the accompaniment of the piano; after a little of this the gas was put out and a lighted candle set in the center of the table. After more hymns in the semi-darkness, gentle raps were heard on the table. Questions were asked orally by the sitters, or remarks made, and answered by the raps; two raps, no; three raps, yes; four raps, good night. Shortly a high, shrill, piping voice was heard; I wasn't sure where the trumpets were, but had no doubt it was one of them. This was Iris, the control—a little girl, an exotic of some sort. She indulged in violent, prolonged and disagreeably shrill laughter at all times. She talked loud and fast and freely, with the circle joining unrestrainedly in her laughter at her own humor and theirs—of which there was a great deal. Sir Arthur thought it would have been impossible for a human voice to maintain consciously throughout the seance the shrill tone of Iris' voice.

Iris demanded that the light be dispensed with, and we sat in total darkness until near the end. I need not describe in sequence or in detail the noises that ensued. Every sound that could conceivably be produced on the instruments I have catalogued, we had, and had repeatedly throughout the sitting. Few of these were musical, most were distinctly unpleasant. The most ear-splitting were when the music-box was lifted and dropped, when the stool was banged violently on the table, and when Iris put forth her best effort on the whistle. The entire evening was one prolonged riot.

Though Iris ran the seance, two other identities took part: John the rapper, and Bell, the violently noisy member. It was for the special delectation of Bell that the tin drumhead had been provided. He used it freely, and also dealt the table some fearful blows with stool and mallet. Save that the sleighbells were apt to go off at any moment, and perhaps also with an exception in favor of the raps, I do not recall that two pieces of apparatus were at any time in simultaneous operation.

No attempt was made to receive messages of significance; the gathering with the spirits was wholly a social one. But the noises were by no means all that happened. Iris wrote on her pad messages for Sir Arthur and myself. One could hear the pencil scratching over the pad, but could not locate this on the table. The completed message was torn off and thrust into the hand of the addressee. I had no sense of physical contact, and no other direct impression that this was done by one of the sitters. My message read: "Dere Mr. Bird, me is very pleased to meet you here tonight. Me thought you would like a few words from me. Iris." The letters were characteristically a child's script. The lines ran eccentrically, two of them actually interfering; while the margins at both sides were highly irregular—all as one might expect if a human were writing in the dark.

Iris could see better in the dark with the trumpet than with the pencil. Her best stunt with this was passing it back and forth across the table, touching Sir Arthur and myself in rapid alternation and with good accuracy, upon our left hands. We were directly opposite one another, the long way of the table. The successive contacts, as marked by our exclamations, were very close indeed—but the fact that two trumpets were on the table made it out of the question to accept the demonstration as proving anything.

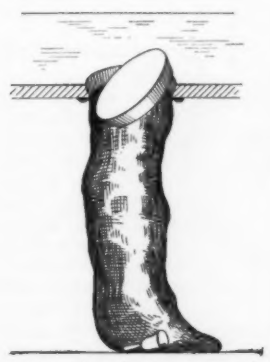
Iris later gave an exhibition of her tugging ability. She brought the big end of the horn to me, so that without releasing my neighbor's hand I could grasp it with thumb and finger. She pulled vigorously and with intelligence; for when she found herself unable to take the horn away from me by straightaway pulling, she twisted it very neatly out of my grasp.

The red-screened lamp had a switch for turning it off and on, which was quite stiff—not really difficult to throw, but requiring a distinct push. While the lamp rested on the table, Iris played freely with this switch, turning the lamp on and off repeatedly. Then she began to move the lighted lamp about the room, back and forth and up and down, over the table and the heads of the sitters, in and out of the circle, smoothly and without any jerk, through wide sweeping curves and figures-of-eight, covering a large range of territory. This went on for some time; to the best of my recollection, the lamp was never turned off or on while in motion. It would appear somewhere, at rest; it would travel about for a moment; it would then come to a stop and be turned out again, or perhaps left burning.

The request was made that Iris materialize her hands, and she agreed to do what she could in this direction. After an interval the slate was held up vertically, and a hand was seen in shadowy silhouette against the bright ground of its phosphorescent surface. The fingers were too thin for a human hand, and too small; and they were quite ill shaped. Iris did not think that she could do any better than this, but under urging she went on, and presently announced that she was going to be able to make material contacts with her hands for Sir Arthur's and my benefit. Presently Sir Arthur felt the touch of a finger-end upon the back of his hand; then it came to me. Here his observations and mine were not in agreement. He found the finger firm, but soft and velvety. It seemed to me that this verdict must be the result of auto-suggestion built about the expectation of a child's finger; for the finger that touched me impressed me as quite coarse and hard. Sir Arthur also got more of an impression of smallness and delicacy than I did, especially in the case of the finger-nail, which we both felt quite distinctly. If nothing had been said about Iris' intent, I should have dismissed the incident with the mere supposition that one of my neighbors had touched me.

The phosphorescent slate was carried about the table (without the hand), and presented to each sitter. The smaller bell, coated inside with the same substance, likewise made the tour of the table. Then the slate and the bell went around together, the bell being tilted this time so that its luminous parts were hidden, and one could see only its dark outline against the bright slate. Though it had rung quite freely before, the bell was wholly silent on this tour.

The climax was reserved for the end. John had rapped "Good night," Iris had actually gone, and the bright light of the gas jet had been restored. I supposed the sitting to be at an end. But John had, as is his custom, remained for one final act, which I must describe in considerable detail.



Section through the center of the table, at the point where the apparatus for the final act of the seance was located. The circular plate is shown in perspective, tilted up in its seat. The bag was fastened to the table clear around the hole, as indicated. The exact amount of the bag dragging on the floor and holding the bell is not known

The setting for the final act of the seance

In the center of the table a circular piece some 18 inches in diameter had been cleanly cut out. This piece had been preserved, intact; and it sat snugly in the hole from which it had been cut, like a plug or lid, the bearing surface being a beveled edge that was carried clear around the circumference of both hole and plug. On this bevel a hole of about a quarter-inch diameter was bored horizontally into the table top; and from the edge of the circular panel a pin projected, fitting into the hole. If one is to remove the circular plate, it must obviously be withdrawn in the direction parallel to the axis of the pin. A mere random thrust from below upon the surface of the circular plate will not with any certainty displace the plate against the locking action of the pin.

To the under side of the table, all around the edge of the circular gap, had been attached a bag of heavy fabric. Sir Arthur and I examined this, finding it quite tight all around its junction with the table, as well as over its own surface. It was long enough to drag upon the floor. In its bottom reposed a large bell with a loose clapper. The idea was obvious—the bag cannot be greatly agitated without causing the bell to ring.

As we sat about the table in full gaslight, the circular plate was repeatedly and violently jerked from its seat and thrust, tilted, out of the hole. John was stated to be doing this; I asked, "Is that you, John," and the plate responded "Yes" with three prodigious upheavals. One of the sitters was able to put the plate back in

its seat only by struggling hard against vigorous opposition. This business continued for five minutes or so, the motion of the plate getting weaker and less frequent all the time; when at length it refused to move any more, the sitting broke up.

So much for the phenomena produced. The entire seance, save for the preliminary sleighbells and the final act with the circular plate, was held in complete darkness; no attempt was made to impose test conditions, or even to apply tests. This prevents any serious opinion's being passed as to the genuineness of the phenomena. It must be admitted that some of them were, intrinsically, far from impressive; and that the whole sitting had a very direct turn toward comedy, horseplay and circus stuff. But it would not be fair to condemn it on that ground alone. We go to seances because we are ready to admit that perhaps there are still some things left for us to learn about the physical world around us. To justify this admission, we need only point out that to have withheld it a generation ago would have been to stop short of the wireless and the airplane. And if an unidentified force or energy is really at work, we make a very large and unjustifiable assumption indeed when we demand that it produce results which shall appear dignified, and in a fashion that shall appear dignified. Our dignity must be left behind us when we enter the seance room, along with our credulity if we be credulous, or our prejudices if we be at all inclined to err in the other direction.

So we can well afford to admit that many of our seance results are unimpressive on their own grounds; and when they are actually funny we can laugh at them without any loss. More serious is the admission that any of our results are such that a single sitter, perhaps with a single hand, could have produced them deliberately, without danger of detection. In the case before us, the most serious obstacle to any hypothesis of extensive fraud is found by balancing human probabilities in connection with the relations existing among the sitters. Nobody, so far as I know, pays any money in connection with these sittings—not even the occasional outsider like myself. This was the one seance I had in Europe for which I did not have a charge of a guinea or more to meet. No attempt is made to gain public recognition of the circle and its results—such recognition is actually shunned, and so successfully that many British spiritists will not identify the group from what I have said about it. In the absence of any medium, we cannot suppose that fraud is committed to give anybody the sensation of being a big frog in a little puddle—there isn't any big frog in this puddle. And if we take the circle to be fraudulent in its entire membership, we must assume that it has been held together for seven years, and brought together once a week throughout that period, for the very intermittent satisfaction of imposing upon the very occasional outsider.

The joining of hands all around the circle is another consideration. Of course this does not at all prevent fraud, but it enlarges the number of sitters who must be participants in any fraud that occurs. If all that was observed could have been done by a single hand, we should require two parties to the guilty secret—the owner of the hand, and his neighbor. If both hands of a single operator were required, we should need three of the sitters in the fraud. If the reader will accept my impression that the phenomena observed would have called for the active cooperation of at least two of the sitters, at opposite sides of the table, the number of tricksters jumps to six. For money or as a casual indoor sport, one might picture half the group as victimizing the other half in this manner; but my imagination falters at the idea of their gathering every week for seven years on this basis.

The rearrangement of the sitters of course was bad. In a majority of my seances a shift of this sort has been demanded, on the ground that it would "make the psychic currents run better." I think it fair to say that this is a very suspicious circumstance; and that in the present instance it becomes doubly so in view of the described rigidity of the seating arrangements, involving no less than four members of the circle.

Of the specific phenomena, the sleighbells were the weakest. By no conceivable means could one know or guess where all the feet were when they rang. In the bargain, their action was always accompanied by a distinct thud, and a jar to the table, exactly as though a material foot had delivered a material jab upon the leather thong. By anything more manageable than a foot, it would seem that they could have been more easily rung by stroking the bells. Of course, the spiritists insist that the psychic operators take fiendish delight in imitating material effects in such style as to throw suspicion upon their own works. But those sleighbells did not ring true to me, and I don't believe they would have rung at all had they been in an inaccessible part of the room. Their ringing in the light, before any of the controls or psychic operators were present, was a grave violation of seance etiquette.

I must insert a testimonial to the pianist. Through two hours of absolute darkness he played brilliantly, and only thrice was he forced to hesitate while he found his place on the keyboard. At times he abandoned the piano for the violin. If the thing were altogether vaudeville, his contribution was by no means the least feature of the program.

The behavior of the lighted lamp was perhaps the most impressive feature of the seance. It covered far too much ground to permit the belief that it was carried in the hand of a single sitter. There was no irregularity in its motion to support the belief that it might have been passed or tossed from hand to hand. It had no wires or other permanent connections upon the end of which it might have been swung.

Like so many other things in my seances, and I am told in seances in general, the travel of this lamp went on with extreme precision. For instance, it swung from a point at the far side of the room, well outside the circle, straight toward me. Had I been leaning forward, it would have struck me squarely; it halted just a few inches short of where my face was at the moment. The very smallest assumption one can make regarding this sort of thing is that it is done by one of the sitters who, by abnormal vision or by other means, is able to locate objects in the dark as accurately and as promptly as the rest of us do in full light. There is no hesitation or exploring, no fumbling; accidental contact is never made with the heads or hands or feet of the sitters, and intentional contact is firm and accurate; and there is never the least bit of rustling, shuffling, breathing, or other indication that one of the sitters is in motion. More than any other feature of seances in general as I have observed them, this demands explanation.

In connection with Iris' fingers, the variability of observation occurring between Sir Arthur and myself is a common incident of seances—and for that matter of court rooms in which two witnesses attempt to describe the same incident. It presents a most interesting study in psychology, but its intrinsic importance in connection with the incident upon which the disagreement occurs is easily exaggerated. It casts no discredit upon this incident; one of the observers is right and the other is wrong, or more likely both are partly wrong—and that is all.

Several of the phenomena seemed to require, for their explanation on a basis of fraud, that the cheating member of the circle actually be upon the table. The tour of the table made by the slate and the bell was one of these. My best judgment was that these objects came far too close to the respective members of the circle to permit the assumption that they were handled by any one member from his seat. But here I may be wrong.

If all the wild noises were done fraudulently, there would have been demanded a great deal of activity on the part of the sitters, but beyond this there was no intrinsic reason why these noises could not have been fraudulently produced. Two or three free hands, and the thing is done. One's general impression, in the presence of a single phenomenon, would doubtless be that it was certainly done fraudulently; but when one sits for two hours, and finds all sorts of different things happening, one on the heels of another, without any direct audible evidences of fraud, one hesitates much longer to make this assumption.

The climax act with the circular plate has made this group of sitters rather famous among the leaders of spiritism in Britain, and is frequently cited as one phenomenon that occurs in the light, under conditions making fraud impossible. While it was going on, I had not examined either plate or bag—that came later, after the conclusion of the seance. I had therefore no idea, while the plate was cutting up, what evidence would be presented that its behavior was supernormal. Consequently I was watching the entire circle as closely as I could for suspicious actions or attitudes; and I found what might have been regarded as this, on the part of one of the ladies. This sitter was either in Sir Arthur's original seat or the one at its right—at the end of the seance, I was not sure which seat he had occupied at the beginning. Throughout the time when the plate was in action, she sat in a curious sideways position, as though trying to extend her foot under the table further than her normal reach would permit. At the same time her body was bent slightly forward, while her head and eyes behaved as though she were peering surreptitiously under the table. I was satisfied that either she was implicated in the movement of the table, or else was trying to see for herself what was going on under the table. Either hypothesis would have met exactly her position and behavior; between the two I was quite unable to choose.

When I finally examined the layout under the table, it seemed clear that the lady, unaided, could not have produced the results observed. That the bag was really tight I am confident. There would remain the possibility of a mechanical connection between plate and table; but the plate offered keen resistance to being replaced, while so far out of its seat as to make this seem improbable. The bag, I am reasonably certain, could not have been air-tight, and in any event there was no escape of air from its mouth when the plate was unseated; so application of pneumatic power must be discounted.

If the plate were displaced by direct human agency working through the bag, from outside, we should have three possibilities regarding the behavior of the bell. First, the bag might be shaken so har that the bell might ring; but it didn't ring. Second, the bag might be so voluminous that its upper portions could be freely kicked and prodded without sufficiently raising the folds at the bottom, or dragging them along the floor, to ring the bell; but this possibility I had in mind while examining the bag, and I concluded that there was not enough of it on the floor for such a result. Finally, one of the sitters might have anchored the lower part of the bag with his foot, while another operated upon the plate through the upper part. But even for this, I was far from certain that there was enough of the bag upon the floor. The motion of the plate would have called for very violent kicking of the upper part of the bag, while the lady of the suspicious attitude would hardly have been able to put much effective weight behind a stabilizing foot.

Beyond this brief analysis of the possibilities I should not care to go, on the basis of a single observation of the phenomenon. I would urge, however, the impropriety of putting forward any argument against it, based upon its "inherent improbability" or any similar ground. We put all this aside when, by investigating psychic phenomena, we admit that maybe they do occur. After this admission, their occurrence is not a question of probabilities or of improbabilities, but one of fact alone.

On another page of this issue I have made it clear why I feel that the issue of fraud versus genuine me-

(*Continued on page 70*)

WE have no space to repeat in detail the conditions for our psychic investigation, published in full in the January issue. For the general convenience, however, we repeat the vital points of this announcement.

The SCIENTIFIC AMERICAN *will pay $2,500 to the first person who produces a psychic photograph, under its test conditions and to the satisfaction of its Committee of Judges.*

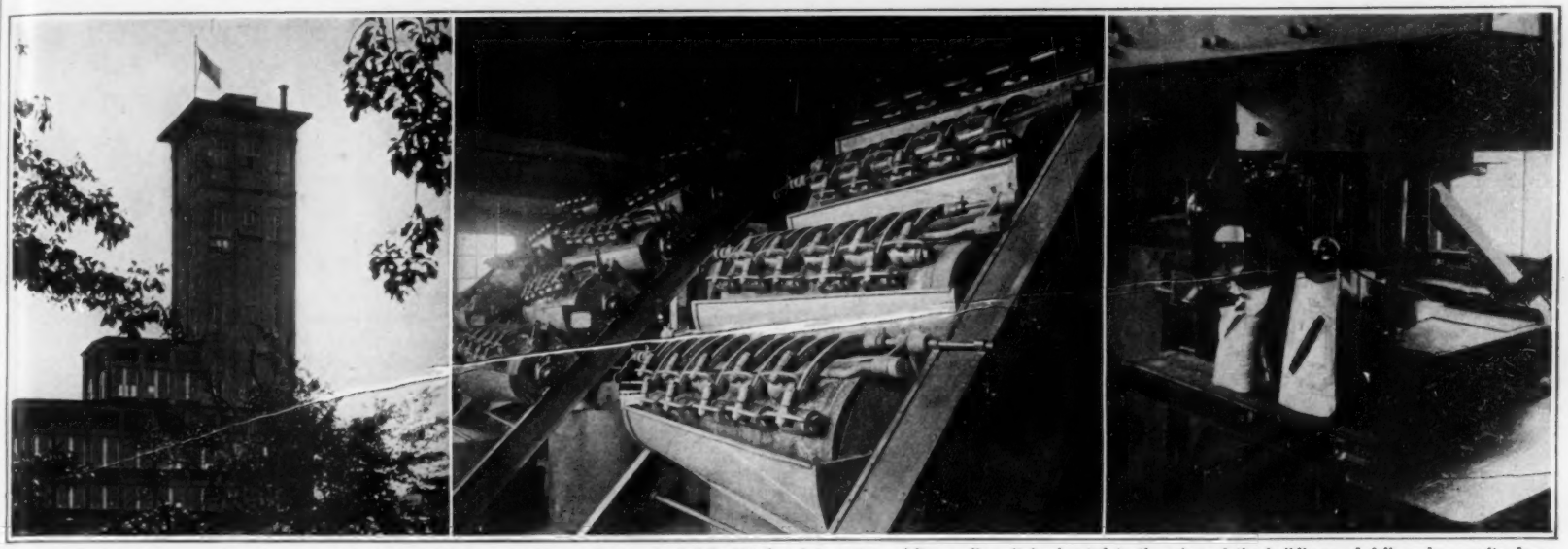
The SCIENTIFIC AMERICAN *will pay $2,500 to the first person who produces, under its test conditions and to the satisfaction of its Judges, an objective psychic manifestation of physical character, other than a photograph, and of such sort that permanent instrumental record may be made of its occurrence.*

The Committee of Judges shall consist of Dr. William McDougall, Dr. Daniel F. Comstock, Dr. Walter Franklin Prince, Dr. Hereward Carrington, and Houdini the conjurer. In the event of death or other disability, a temporary or permanent substitute for any Judge may be named.

Entry must be made on or before December 31, 1924, to the Secretary to the Committee, at the SCIENTIFIC AMERICAN *office in New York.*

Either award will be made on unanimous vote of the Judges, or on a four-to-one division. Seances with any medium shall terminate and all his claims to the award be vacated upon rejection of his mediumship by formal vote of the Committee.

All the conditions for entrance, seances, etc., which are laid down in the full announcement of our January issue, are part of this offer.—THE EDITOR.



Left: The shot tower. The molten lead alloy is dropped from a sieve at the top and falls 154 feet into water. After cooling, it is elevated to the wing of the building and follows by gravity from process to process. It is given a preliminary polish and then passes over a series of sloping plates having small gaps which the truly round shot are able to jump; while the imperfect ones cannot get up enough speed to jump the opening. *Center:* Assorting for size. The revolving screens are continually traversed by rollers which keep the shot from remaining wedged in the screen. *Right:* After the shot have been assorted they are given a final polish and bagged for shipment

From beginning to end of the process of making shot there is no need for the workmen to touch the shot. Each of the several processes is done by machine and gravity carries the shot from stage to stage

Mathematically Perfect Balls of Lead Called Shot

IF the end of an ordinary shotgun shell be uncrimped, out will roll scores of shining shot, beautifully burnished, perfectly graded as to size and absolutely round. Without these prerequisites the hunter will have just cause to complain of the charge of shot in the shells he uses. If the individual pellets are out of round, or if they vary in size, he will return from the hunt with less game in his shooting jacket, regardless of how good a shot he is, than he otherwise would. And a charge of shot, fired under test conditions at a prepared target will show up the cause of the disappointment. The pattern will be less perfect, many of the bullets having fallen short because their imperfection results in a lower velocity through the air than the average of the charge, while others are diverted from the theoretical course because they are not round.

To produce, day after day, year in and year out, shot that are truly alike, true to gage, round, equally burnished and equally hard because of identical composition and identical methods of production has required the perfection of a process, which, far from being merely the dropping of a lot of melted lead from a sieve into cold water, is highly specialized from start to finish, involving the previous manufacture for the purpose of a whole family of special machines and the training of a special force of mechanics in traditions of care and accuracy. The descent of drops of molten lead from a high tower into water, although an ancient method of making shot, is still retained, but only as the heart of a lengthy but modern scientific process. With it is retained the ancient shot tower, and it is one of these structures, a landmark on the skyline of New Haven, Conn., which contains all the special machinery that turns lead and antimony, in varying proportions according to the degree of hardness desired, into 50 tons of shining pellets every working day.

From the time the molten lead pours from the big cauldrons in the top of the tower until the shot is delivered over the counter in the shell it is not touched by human hands. The whole chain of processes is automatic. Gravity moves the product from machine to machine, and the machine does all of the work.

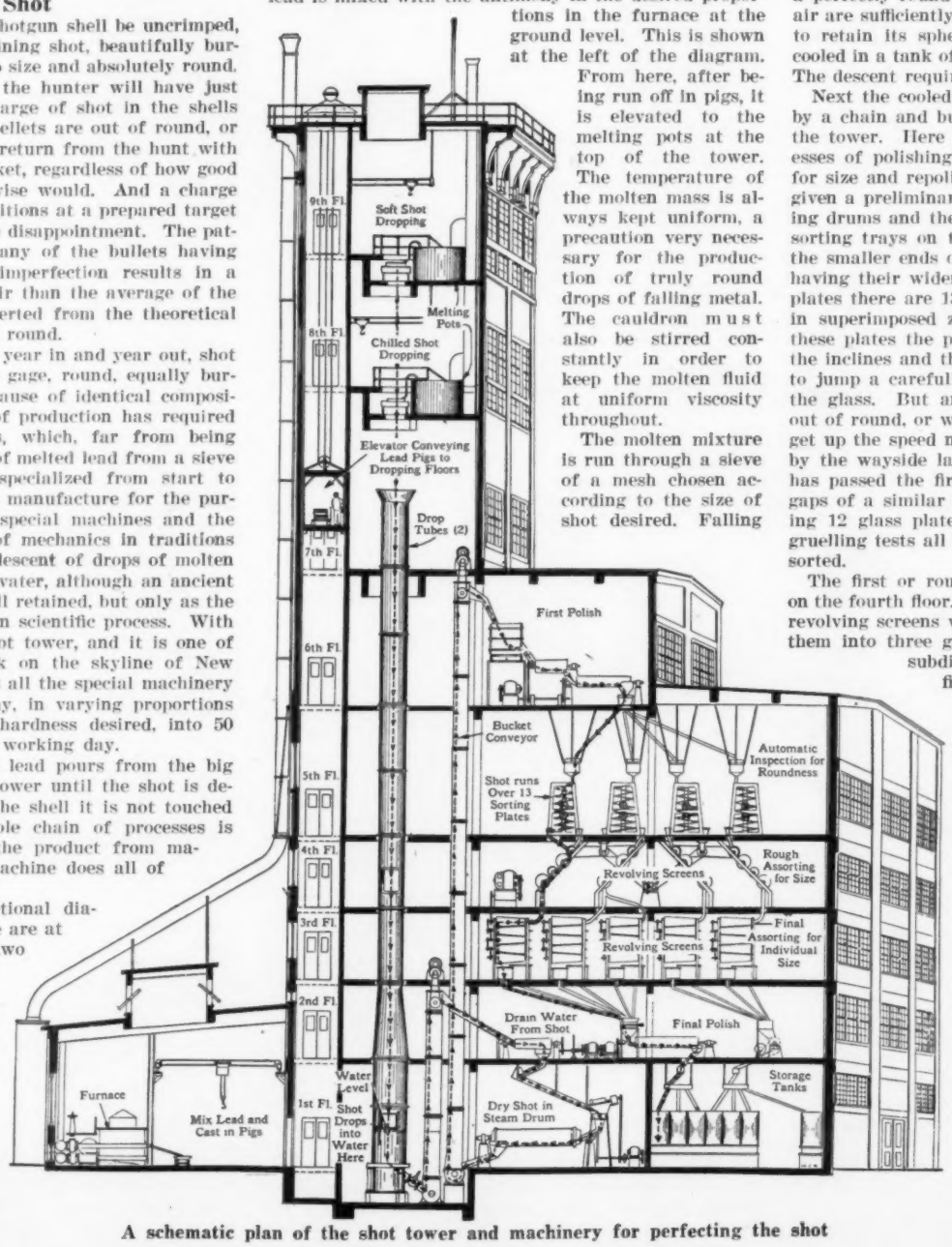
As shown in the cross-sectional diagram of the shot tower, there are at its top two melting pots and two drop tubes. The significance of this is simply that two kinds of shot are provided for, the chilled and the soft or drop shot. These varieties are made by using different percentages of antimony with the lead. Otherwise the two are made in exactly the same manner. Therefore in our description we shall omit the lower melting pot and follow through the manufacture of drop shot from the upper of the two cauldrons. The lead is mixed with the antimony in the desired proportions in the furnace at the ground level. This is shown at the left of the diagram. From here, after being run off in pigs, it is elevated to the melting pots at the top of the tower. The temperature of the molten mass is always kept uniform, a precaution very necessary for the production of truly round drops of falling metal. The cauldron must also be stirred constantly in order to keep the molten fluid at uniform viscosity throughout.

The molten mixture is run through a sieve of a mesh chosen according to the size of shot desired. Falling thence through a distance of 154 feet, the drops assume a perfectly round shape, and as they fall through the air are sufficiently cooled to form a crust strong enough to retain its spherical shape until the shot has been cooled in a tank of water at the bottom of the structure. The descent requires but 3.1 seconds.

Next the cooled shot are dried by heat and returned by a chain and bucket elevator half way to the top of the tower. Here are begun the several finishing processes of polishing, inspecting for roundness, assorting for size and repolishing. At the sixth floor the shot is given a preliminary graphite polish by two large rotating drums and then it descends by gravity to the glass sorting trays on the fifth floor. Here it is carried to the smaller ends of a series of glass, fan-shaped plates having their wider ends inclined downward. Of these plates there are 13 in each tier and they are arranged in superimposed zigzag form. As the shot roll along these plates the perfectly round ones run freely down the inclines and the speed thereby gained enables them to jump a carefully adjusted gap at the lower edge of the glass. But any individual shot which is slightly out of round, or which is imperfect in any way, cannot get up the speed necessary to make the jump and falls by the wayside later to be remelted. The shot which has passed the first gap must, however, pass 12 more gaps of a similar nature, corresponding to the remaining 12 glass plates. At the end of this series of 13 gruelling tests all the shot is considered to be perfectly sorted.

The first or rough sorting for size now takes place on the fourth floor. Here the pellets are passed through revolving screens which are perforated in order to sort them into three general sizes, the more particular or subdivided sorting of the products of these first screens taking place on the floor below. The shot is now given a final polish which adds the perfect luster which characterizes good shot, and it is thence conducted to the storage tanks.

Tests for diameter, number of pellets per ounce, hardness, roundness and general appearance are now made on the finished product. Chilled shot, being harder than drop shot, is not mutilated as much when fired from the bore of a shotgun, and therefore gives better patterns. The makers, knowing that soft shot has better killing powers than chilled shot, due to the upsetting of the shot in the game, have found it necessary to have a standard hardness for each individual size of shot. The poured shot runs in size from dust to size TT, making a total of 20 sizes. But the nine sizes of buckshot are cast. There are also ten sizes of lead balls which are cast, ranging from the .44 caliber to the 10 gage ball.



A schematic plan of the shot tower and machinery for perfecting the shot

Where Corn Is King

Why Our Agricultural Prosperity Depends Largely on Our Annual Hundred Million Acres of Corn

By George H. Dacy

FROM the 30-acre field of corn which was cultivated and harvested by the colonists of Virginia in 1609, our annual corn production has developed and increased until now we devote more than one hundred million acres of our best land to this king of cereal crops. Both in acreage and value, corn is the most important crop that American farmers grow. According to the census of 1920 there were 6,448,343 farms in the United States and last year 76.5 per cent of them raised an average of 18 acres of corn per farm. In nine of the last twelve years, our corn crop has been worth more at market time than both our wheat and cotton crops. In eight of the last twelve years, the value of our corn crop has been greater than the combined values of all our cattle and swine produced for slaughter.

Corn, our kingpin crop, is put to many uses. The porker families which always are most numerous close to the scene of maximum corn production convert four-tenths of the American corn crop into meat and lard. Horses consume 20 per cent and cattle eat 15 per cent of what remains. Ten per cent of the crop is converted into human food, being consumed on farms and ground in merchant flour mills. Corn is also used extensively in the form of silage, fodder and stover as a feed for domestic livestock. It takes four million acres of corn annually to fill the hundreds of thousands of silos which now dot the landscape in the leading dairying and livestock districts of the country. Two million acres of corn are harvested each year by hogs and sheep that are fattened for market on the cafeteria system in these grain fields. In excess of 2,500,000 acres are cut for fodder each year.

Six of our States, including Iowa, Illinois, Nebraska, Missouri, Indiana and Ohio produced 48 per cent of our entire corn crop as well as 45 per cent of our pork supply and 25 per cent of the beef which goes to feed our 107,000,000 people. Corn is king not only because it occupies more of the farmer's time and attention than other crops, but also because it is the principal source of food for the American people, either when consumed directly for human nourishment or converted into meat products. Three-quarters of the world's annual corn crop is produced in the United States. There is no other corn growing region which equals the famous American corn belt. Argentina, Brazil and Mexico grow considerable corn, most of which is consumed at home, except in the case of Argentina where the output is largely exported.

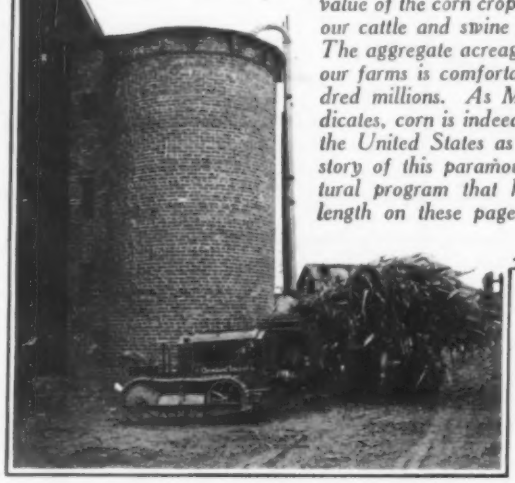
European countries raise one acre of corn to every four that are grown in the land where the Stars and Stripes are the national emblem. Among the leading foreign growers of corn are Italy, the Balkans, Hungary, Spain and Portugal. Southern France also grows some corn, while the Rumanian and Hungarian plains, most nearly approximating the American corn belt in soil and climate, produce considerable corn for home consumption and for export purposes. The people of India and Egypt grow much corn under irrigation and use most of the food locally. During the last three years, the world crop of corn has aggregated about 3,500,000,000 bushels. As the United States is the leading producer, the world output is generally abundant or short in direct proportion to production in this country.

Corn was the earliest cultivated crop grown on American farms. The Indians taught the early settlers in the Virginia and Massachusetts colonies how to plant, cultivate and harvest corn. Originally, the only tools used were crude hoes and spades. But soon the colonists introduced English plows, and from that time to this the development and use of labor-saving machinery to abet corn-raising operations has been epochal. It is notable that the Massachusetts settlers used old Indian cornfields for raising their first corn crops. They followed the primitive system of placing a fish in each hill of corn as fertilizer.

Directly after the Revolutionary War, the fertile lands of Tennessee, Kentucky and the Northwest territory were settled. Corn was raised as the chief crop and was marketed principally in the form of whiskey and fat cattle. As settlement was extended corn production developed. The perfection of the railroad aided this movement greatly and extended the available marketing points. The Civil War retarded production for several years. Thereafter corn raising boomed. About 1876, freight rates were lowered and this permitted shipping corn and fat livestock great distances at a profit. The development and extensive use of more efficient and powerful machinery, and the breeding of better strains of corn and improved methods of marketing the crop all aided in making corn the preeminent crop in the United States.

The peculiar condition prevails in the American corn belt that although the soil, climate and marketing facilities make it the ideal corn producing region, not over 40 per cent of the land is devoted to corn. One-half of the cropping land is occupied by small grains and hay, not because these crops are more profitable, but because crop rotation must be practiced and the seasonal distribution of labor satisfied. Hay and small grains do not compete with corn for the time and attention of the farmer. They can be grown when he has spare time from his corn growing responsibilities. Neither their planting, cutting nor threshing interfere with the corn campaign.

BOTH in acreage and in value, corn is the most important of America's crops. In 1920 there were 6,448,343 farms in the country, according to the census enumeration. Last year, 76.5 per cent of these farms raised an average of eighteen acres of corn per farm. In nine of the last twelve years, our corn crop has been worth more in the markets than the combined wheat and cotton crops. In eight of these twelve years, the value of the corn crop has exceeded that of all our cattle and swine produced for slaughter. The aggregate acreage planted in corn on all our farms is comfortably in excess of a hundred millions. As Mr. Dacy's headline indicates, corn is indeed the king of crops, over the United States as a whole; and it is the story of this paramount item in our agricultural program that he tells at considerable length on these pages.—THE EDITOR.



Climatic capers prevent corn from being raised profitably in all parts of the country. The growing season must be at least 130 to 140 days in length. Rainfall must be sufficient and well distributed. Early frosts must not intervene to damage the corn seriously at a time when it is just maturing. The present aim of every corn breeder is to develop strains that will mature very early, as such achievements permit of extending corn raising operations farther northward. Some of the southern varieties of corn require six months of growing season while some of those grown in the North will mature in half that time. Little corn is grown in the Far North and West because climatic conditions are unfavorable.

Our annual corn crop is exposed to so many insect enemies and diseases that the producers are often hard put to it in certain localities to make the crops worth while. Corn smut and the root, stalk and ear rots are the most objectionable diseases that prey on the corn, while such insect pirates as the chinch bug, the corn-ear worm, the white grub, the corn root aphis, the grasshopper and the European corn borer jeopardize yield and quality. Smut causes a loss of about 80,000,000 bushels annually. No effective control has been developed. The best protection is for farmers to plant smut-resistant strains of corn which have been bred up to withstand the attacks of this pest. Root, stalk and ear rots cause losses aggregating 122,000,000 bushels a year. Seed treatment, the rotation of crops and the maintenance of soil fertility are the best preventive measures against the crop despoiling diseases.

No picture of our national life and prosperity is complete unless it contains a depiction of our corn crop which is the determinate yardstick that annually measures our agricultural prosperity. The history of corn-growing is really a history of our national progress. Each is replete with the same number of successes and reverses, achievements and vicissitudes. Averages apply to corn production as they do to every other variety of agriculture or industry. Periods of inflation are followed by eras of depression; low prices succeed high values; over-production follows shortage. But the law of averages over centuries equalizes the balance and shows how, slowly but surely, corn cultivation and harvest have steadily increased in the United States to the permanent and far reaching benefit of our agriculture.

Although on two different occasions during the last decade, our annual production of corn has exceeded three billion bushels, at no time during this period have we exported more than 120,000,000 bushels in one year. Our population is increasing constantly. We have more mouths to feed at home and this prevents any large amount of our corn crop being shipped abroad. In 1899, we exported 10.3 per cent of our corn crop but since that time our yearly consignments to foreign countries have not been more than three per cent of our output. The corn that we export usually goes to the United Kingdom, Germany, Canada, Netherlands, Denmark, Belgium and Cuba, and is used as feed for dairy cattle and other livestock.

Argentina is more important as a corn exporting country than the United States despite the fact that her annual production is considerably less than that of the State of Iowa. However, the domestic consumption in Argentina is not large. One year, she exported 190,351,000 bushels, while her foreign shipments to Europe have, during recent years, annually amounted to approximately 90 per cent of that figure. Exports of Argentina corn to the United States have never been large and probably will not attain great significance unless our population increases out of all proportion to the resources of our domestic agriculture. Foreign buyers claim that Argentina corn is better than that produced in America because the kernels are smaller, making it better adapted to poultry feeding; that it is sweeter and makes a better horse feed; and that it contains 3 to 4 per cent less moisture and so will ship and keep better. Moreover, there are merchandizing and international trade features which make Argentina corn more popular on the French and Belgium markets than that of the United States.

The fundamental factors that will determine the potential profits in corn production are supply and demand. Latterly, these have been so nearly balanced that a slight variation in either has markedly influenced the price. The supply is always determined by the carry-over of the previous year, plus the current crop. Recently the production has been largely dependent on yield per acre, which, in turn, depends on the season. A decrease in yield of only three bushels an acre over the entire United States would approximately offset the total production of Illinois, one of our leading corn-raising sections. The price of corn has recently been low, due to post-war conditions. Many farmers have inclined toward minimum production until profitable prices again obtain. These conditions have obtained largely as a consequence of the curse of plentiful production rather than because of the curse

of famine. Record crops, heavy carry-over and money scarcity following the war have depressed the prices of agricultural products which are the first to reflect such internal conditions.

Through organized effort providing for storage and necessary credit, marketings of corn can be spread over a longer period in the future, and thus excessive reductions in prices as a consequence of rapid marketing at harvest time can be avoided. Farm organization of a sound, wise and far-seeing character is the key to a more prosperous and better paid agriculture. Advancement in farm organization must go hand in hand with the improvement in the distributive machinery of the country. Potentially, American farmers must adjust their production to accord with national and world demands. If the world requires less pork and beef, the corn grower will have to modify his farming to coincide with such conditions. Our increasing population will probably demand much more beef and pork and this will mean that we must increase our corn production. The extent to which meat will constitute a part of the diet of this larger population will have an important bearing upon future corn production.

The Fourth Dimension

THERE is a strange delusion that the fourth dimension must be something wholly beyond the conception of the ordinary man, and that only the mathematician can be initiated into its mysteries. It is true that the mathematician has the advantage of understanding the technical machinery for solving the problems which may arise in studying the world of four dimensions; but as regards the conception of the four dimensions of the world his point of view is the same as that of anybody else. Is it supposed that by intense thought the mathematician throws himself into some state of trance in which he perceives some hitherto unsuspected direction stretching away at right angles to length, breadth and thickness? But that is an error.

The world of four dimensions is perfectly familiar to everybody.

It is obvious to everyone—even to the mathematician—that *the world of solid and permanent objects* has three dimensions and no more; that objects are arranged in a threefold order, which for any particular individual may be analyzed into right-and-left, backwards-and-forwards, up-and-down. But it is no less obvious to everyone that *the world of events* is of four dimensions; that events are arranged in a four-fold order, which in the experience of any particular individual will be analyzed into right-and-left, backwards-and-forwards, up-and-down, sooner-and-later.

This news that the events around us form a world of four dimensions is as stale as the news that Queen Anne is dead. The reason why the relativist resurrects this ancient truism is because it is *only in this undissected combination of four dimensions that the experiences of all observers meet.* In our own experience one dimension is sharply separated from the other three and is distinguished as time; but our experience is solely terrestrial, and if we insist on building the scheme of nature on purely terrestrial experience we are limiting ourselves to the medieval geocentric system of the world.

We must try another plan. We can never eliminate altogether the human element in our conception of nature; but we can eliminate a particular human element. If our thought must be anthropocentric, it need not be geocentric. We must leave the space-time frame entirely indeterminate. When we do that, we find that the world common to all observers—in which each observer traces a different space-time frame according to his own outlook—is a world of four dimensions. When we look at any object, say a chair, the impression on our eyes is a two-dimensional picture depending on the position from which we are looking; but we have no difficulty in conceiving of the chair as a solid object, not to be identified with any one of our two-dimensional pictures of it, but giving rise to them all as the position of the observer is varied. We must now realize that this solid chair in three dimensions is itself only an appearance, which changes according to the motion of the observer, and that there is a super-object in four dimensions, not to be identified with the three-dimensional chair in Ptolemy's scheme, or the same chair in Copernicus's scheme, but giving rise to both these appearances.—*Abstract from Romanes Lecture, 1922, by Professor A. S. Eddington.*

Corn is produced on a very large scale for ensilage purposes

A New Vitamin Bread

THE discovery of a newly-perfected bread is the result of extended investigations conducted by the Mellon Institute of Industrial Research of the University of Pittsburgh in direct cooperation with the baking experts and scientific staff of a leading baking company and a group of retained specialists in food chemistry.

Our corn belt produces 48 per cent of the corn crop, 46 per cent of our pork, and 25 per cent of our beef

According to Edward R. Weidlein of the Mellon Institute, there has been developed and put into successful commercial practice a method for the extraction of vitamins and mineral salts from the germ of the wheat berry. These products are used for enriching white bread in order to impart complete nutritive value and dietary balance. Dr. Weidlein says that the food value of bread was formerly ascertained by chemical analysis, but that analysis fails to tell the entire story, the only accurate determination being obtained by feeding experiments on human beings or animals.

It was proved that the best white bread, if used as an exclusive diet, will not support life indefinitely. It was lacking in vitamins and mineral salts. When these were added, great improvement was noted. It was further found necessary to add milk proteins in place of water, and to balance the mineral salt constituents by the addition of the new wheat germ extract. The new bread resulted, and it is claimed that this perfected product, with only the addition of water to the diet, will sustain life indefinitely.

The significant part of the discovery lies in the recognition that some of our milling processes have been depriving our bread of their vitamins and mineral salts. The experience thus gained by the tests is a recapitulation of that gained by the soil expert. Until recent years it was believed that a chemical analysis of soil samples truly indicated the qualities of that soil, as well as the particular elements to be added to it in the form of artificial fertilizers. Today it is known that while such an analysis is of value in soil treatment, it is not the last word. It was often found that the addition of the elements indicated as lacking by the analysis did not produce the desired results. It is now recognized that the best way to determine what the soil needs is to experiment with the life that grows from it. If one wishes to know, for instance, whether a certain kind of soil will raise potatoes well, it is necessary to try growing potatoes on it, that is, to "ask the soil." Analogously, in finding a bread that is a complete food it is necessary to "ask the body" by trying it as a complete food. Such tests, supplemented by chemical analysis in order to check up on the exact nature of the modifications made from time to time, finally brought out the desired loaf.

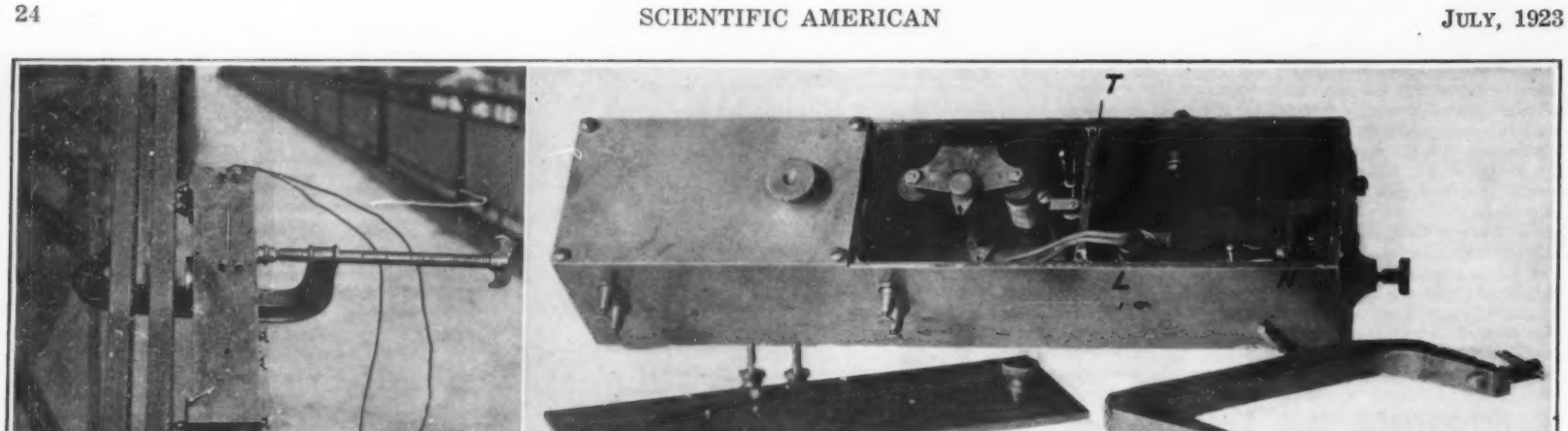
At market time our corn crop usually is worth about as much as our wheat and cotton combined

Water and the Climate

EVERYONE knows how much more steady is the state of the weather on small islands at great distances from continents than in most other places. Everyone knows how much milder the climate is, how much cooler in summer and warmer in winter, at the seashore than a comparatively small number of miles inland. This phenomenon depends on the water.

How does it depend upon water? What is the effect that water exerts in that respect? There are several factors. In the first place, it takes a great deal of heat to raise the temperature of water, or, as the physicist says, the specific heat of water is high. If you take, for instance, a pound of water and a pound of almost anything else—there are a few substances that are harder to heat than water—and heat them over a carefully regulated flame for a certain length of time, and measure the rise in temperature, you will find that the rise in temperature of the water is less than that of the other substance. There are a few exceptions, but there are very few. The result is that an ocean or a lake absorbs heat, and does not itself rise very much in temperature.

Again, the evaporation of water takes up heat. Everyone knows that. Everyone knows that in order to evaporate water away at all rapidly you must heat it, and the amount of heat that is taken up in this evaporation of water is greater than in the evaporation of anything else; that is to say, you have got to put more heat into water in order to boil away or to evaporate, let us say, a pound of it, than you have in order to evaporate a pound of anything else. Thus the more rapid the evaporation the more effective the resistance of water to the rise of temperature, and for that reason the cooler the climate in the marine region compared with the climate in a region where there is no water to evaporate. This is one of the most important of all economic factors on the earth. It is a factor that, as much as any other one, perhaps, determines whether a given part of the earth is or is not really favorable for a high and active and prosperous civilization.—*Abstract from article by Professor L. J. Henderson, Scientific Monthly for November, 1922.*



Left: The recording instrument clamped to a member of a bridge truss, with its fixed and movable gage points in contact with the truss member. *Right:* Interior of the recording instrument, showing the reels for the photographic recording film, the electric light for throwing the indicating beam, and the little mirror at *N* which reflects the beam to the film

The apparatus for detecting the stress actually produced in any member of a bridge with live load

When a Bridge Tells Its Troubles

A New and Ingenious Device for Measuring the Effect of Traffic on Bridges

A NEW device has been perfected by the U. S. Bureau of Public Roads which will determine the stress produced in any member of a bridge when a vehicle or train passes over it, no matter how great the speed. Engineers have long known how to design a bridge so that it may safely carry its own weight plus the load standing on it, but when it came to making a correct allowance for the impact which every moving load produces, they have had to estimate. The new apparatus is designed to furnish data long sought by engineers, so that in the future they will be able to prepare designs based on accurate information rather than on the mere attempt to make a liberal allowance.

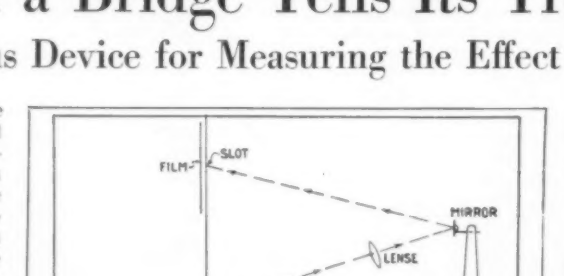
The device used, as described by E. B. Smith of the Division of Tests, makes a photographic record, by means of a beam of light, of the lengthening or shortening of any part of the bridge. From the data thus gained, when the size of a member is known, the stress in it can be calculated; and by other calculations that part of the stress which is produced by impact can be determined. Such information can be used in the design of new bridges.

The design of the measuring instrument is based on an optical principle, its essential features being shown in the diagram. *A* and *B* are the two gage points, *A* being movable and pivoted as shown. At its upper end is attached, by means of an adjustable fixture, a mirror. By means of a small lens a source of light is focused on this mirror and is reflected back to a photographic film.

In operation, any slight movement of the point *A* will rock the small mirror about its pivot, thus deflecting the beam of light and very greatly magnifying the original movement. By thus using a beam of light to magnify the movements of the bridge member it is made possible to eliminate all but two moving parts, namely, the gage point with its extension and the mirror on its pivot. Since the movement in either case is extremely small, these parts respond readily with very little component effect of inertia. The greater part of the magnification is obtained by the movement of the reflected beam of light, caused in turn by the movement of the mirror, and as the former takes place without any effect of inertia whatever there can be no lag or overtravel of the recording beam. In order to make the instrument recording, a photographic film is so placed as to receive the beam of light which passes through a slot and makes a direct record of the variations in the bridge member on the film.

As shown in the photograph of the instrument, *L* is a small electric light whose filament is focused through the lens on the small mirror at *N*. The image of this filament is reflected back across the vertical slot located in the partition of the instrument at *T*. Past this slot a roll of film is caused to move and receive the record. This motion is imparted to the film through a train of worm gears, driven from a small electric motor that is run by a storage battery. This battery also supplies current to light the filament.

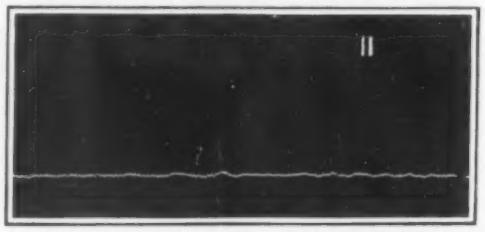
With this instrument it is possible to get magnifications of more than 500 times the amount of the original deflection, but for most cases 200 times has been found ample. The amount of magnification is calculated by placing the device on a specially constructed block and by means of a micrometer screw, moving the gage point to a known extent and then measuring the record produced on the film.



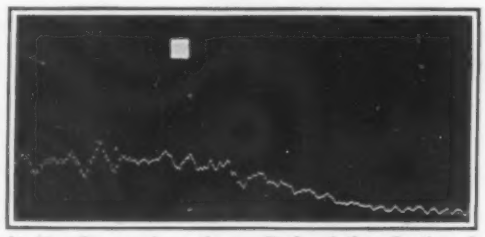
Movement of the gage point *A* with regard to the fixed gage point *B* caused by the stretching of the bridge truss member is greatly magnified at the upper end of the lever whose shorter end forms the moving gage point *A*. The beam of light is focused by the lens on the mirror, whence it is thrown on the moving film, leaving a graphic record

Diagram showing principle of the recording apparatus

At 3 miles per hour. The effect is very slight and uniform



At 9 miles per hour there is no marked oscillation of the bridge, but the curves have greater amplitude. The entire curve lies above the line, showing a slight "stretch" in the member



At 20 miles per hour the amplitude of the vibrations is much more pronounced, and the trend of the graph shows local oscillations in the truss as well as long, slow swings of the bridge as a whole

Graphic records made on the lower C-cord of a six-panel Pratt truss bridge by the passage of a 3-ton truck

Intensity and Duration of Fire

SOME experimental work has been undertaken by the Bureau of Standards in connection with investigations of the fire-resistive properties of building materials, to determine the actual fire exposures to which building constructions may be subjected as used to house various occupancies. In furnace fire tests of such constructions, they are subjected to fire exposure the intensity of which is determined according to a standard time-temperature relation, which has been thought to represent a moderately severe building fire, the duration of which will depend on the building construction and building contents, the latter being determined in a general way by the occupancy. Fires of long duration and high intensity are produced by such occupancies as heavy manufacturing, merchandising, and storage, with office and residence occupancies at the other end of the scale, as giving the lowest duration and intensity.

In the latest test which the Bureau has carried out a small building was constructed and furnished in such a way as to simulate an office occupancy. It was then burned out in a manner calculated to approximate an exposure fire. While interesting survivals of the contents of a safe were obtained, it is apparent that to be conclusive further experiments will be necessary, particularly to determine the effects of larger room dimensions on intensity and duration. Efforts are also being made to obtain an estimate of intensities of fires in buildings by examination of fire ruins. An inspection made of the Burlington Building (Chicago, Ill.) after the fire of March 15, 1922, indicated that maximum temperatures between 950 degrees and 1050 degrees Centigrade (1742 to 1922 degrees Fahrenheit) obtained generally over the burnt portion to judge by fused metals, the melting points of which were later ascertained. At a few locations the temperatures apparently exceeded these averages by about 100 degrees Centigrade.

Corrosion of Engine Crank Cases

IN connection with the work on reclaiming lubricating oils, something has been done in cooperation with others interested in two examples of corrosion of engine crank cases. It has been thought for some time that the most serious part of crank-case dilution was the resulting corrosion which occurred if the fuel contained too much sulfur, the sulfur being due either to that in the crude oil or in the benzol used in blending the fuel. In the present instance, the trouble in all probability was due to the use of fuel distilled from a Mexican crude oil which is high in sulfur, as it was found that benzol fuels had not been used, and it is known that there is a tendency toward the increasing use of Mexican crude oil. It is, of course, in the cold season of the year that crank-case corrosion is at its worst owing to the greater amount of crank-case dilution.

A New Gasoline-Electric Freight Train

THE "giant" freight train designed by the Austro-Daimler Motor Company, of Vienna, is made up of two vehicles: first, the engine car or tractor, carrying the gasoline-electric set for generating the electric energy required for propulsion and for controling the train service; second, a trailer, destined to receive the useful load.

The tractor, which itself carries no useful load, is a double-axle vehicle fitted with a 150-horsepower water-cooled six-cylinder gasoline engine, rigidly coupled to a 90-kilowatt continuous-current dynamo, as well as with all accessories such as electric lights, starter, auxiliary carburetor, etc., and a capstan installed at the rear end of the tractor. In addition to a self-acting vacuum brake, the vehicle carries a hand-operated brake. The rear wheels are driven from two electro-motors, each of about 15 horsepower. The tractor is designed for traveling both on the road and on rails—on standard-gage tracks as well as on the wider Russian tracks.

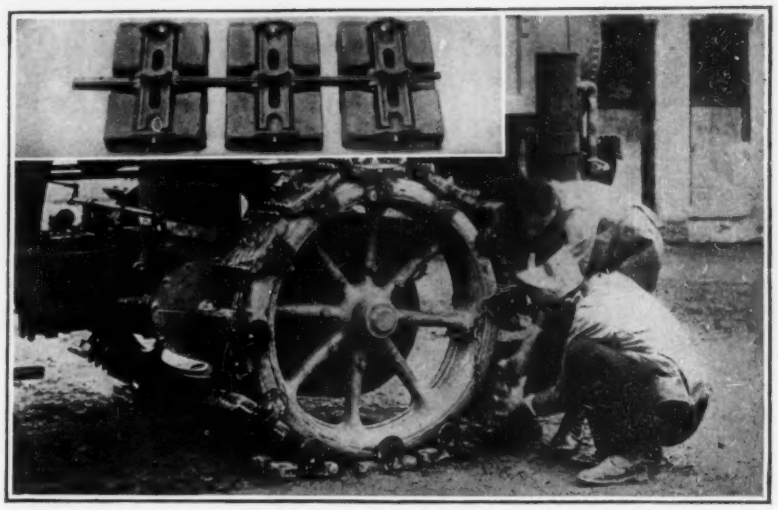
The trailer carries its considerable useful load of 25 to 30 tons distributed over four axles in order to insure an axle pressure as low as possible. All eight wheels are driven by electro-motors, thus warranting the tractive force required. The trailer mounts both a self-acting vacuum brake and hand brakes, thus insuring safe braking of considerable loads on gradients. The four-axle trailer is made up of two pairs of single-axle bogies connected together by horizontal joints and constituting the front and rear cars respectively, which, in turn, are joined by a girder. The weight of the tractor is about eight tons, that of the trailer about 15½ tons. The maximum traveling speed of the train on level hard roads of medium quality is about 10 kilometers per hour, and its maximum climbing capacity is a grade of 23 per cent. All these data are relative to full-load operation.

Another Cotton Picker

AMONG the inventions of the past few years have been several cotton pickers of unusual promise. That it has always been necessary to pick cotton by hand is well known, as are the enormous economies and the expanded production that would result from a completely successful machine picker. We have illustrated one or two recent attacks upon the problem, and now we show another.

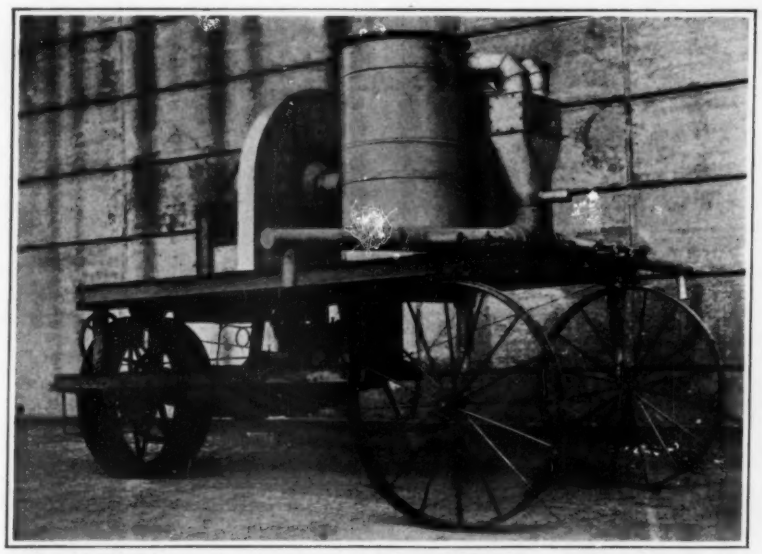
This machine is designed primarily to be run from a cheap gasoline engine, since, while electric drive is quite practicable so far as the machine is concerned, it is not very convenient for use in the cotton fields. The picker alone weighs 700 pounds, and can actually be pulled by horse or by hand, if necessary. It is small enough to pass between the rows, and by means of a wide extension bar which carries the suction nozzles far to the side of the machine, it can be made to pick eight or ten rows in a single trip across the field. The suction not only picks the cotton, but gathers it in bags aboard the tractor. The cotton is gathered through a hose twenty-five feet long, and all that the operators—one to each nozzle—have to do is to carry the nozzle to the plants and about them to the individual blooms. As fast as the operator can touch the nozzle to the cotton it flies out, passing to the bag in the tank. It is claimed that four operators on the nozzles and a fifth on the machine to take care of the air supply can gather at least 5000 pounds of cotton a day.

A powerful suction rotary pump is used, handling a large volume of air at low vacuum. Two tanks are employed, so that air can be shunted from the full one to the empty one in connection with the emptying of the tank of cotton, making it unnecessary for the pickers to stop their work. It is emphasized that the cotton is picked absolutely clean—that it "points out and begins to go" before the nozzle even touches it, and that there is no necessity for taking any leaves or parts of the pod. The entire handling of the cotton after it is removed from the boll is taken care of, automatically, by the machine, which differs materially from others already described.



Improved type of traction belt for automotive use, and (insert) a detail of the shoes and their connections

Separate views of the tractor and trailer of the new Austrian gasoline-electric road train



Five thousand pounds of cotton in a day by five men is the claim made for this suction picker

The Centipede Wheel

POWER without traction is proved useless every time a rear wheel spins or skids. The caterpillar idea in one form or another obviously gives the most nearly infallible traction that one can hope for. But the caterpillar has disadvantages which have heretofore limited it to agricultural work in heavy ground, where its advantages outweigh its drawbacks. An Italian artillery captain, M. Guerrini, has perfected the apparatus illustrated herewith, designed to bring caterpillar efficiency to road vehicles, divorced from caterpillar cumbersomeness, slowness and multiplicity of parts.

The Guerrini device, in a simple and practical manner, provides any driving wheel with an anti-skid traction apparatus which has a large bearing surface and is light and easily removable. It is in fact a veritable caterpillar in which the rollers, gear wheels and like parts are suppressed, and their functions performed by shoes attached to the driving wheels of the vehicle. In the case of road tractors and rubber-tired vehicles these shoes are applied by means of a belt which can be quickly adjusted and stretched over the tires; and in other cases, such as agricultural tractors, without a belt, by means of independent shoes mounted around the wheel in the way chains are sometimes mounted. We may confine ourselves to the first case, since the second will be clear from it. The belt consists of a certain number of links and stretching screws by means of which the assembly can be drawn tight about the wheel. During the rotation of the wheel, the tires revolve upon the inner surface of the shoes, which are successively laid upon the ground. When the shoe has been replaced by the preceding one, its tunnnions reach the upper end of their course, raise the shoe, and turn it about so that it is ready to be planted in the ground again. At every revolution of the wheel, the shoe will first drop by its own weight against the tire, and later will be tilted forward; these two sudden displacements in opposite directions will shake the shoe and usually free it from clinging earth.

It is the system of suspension involved that is claimed to constitute a simplification of the caterpillar system. Indeed the shape and proportions of the suspension are such that the kinematic couple comprising trunnions and suspension holes serves not only for placing the shoes in front of the wheel and raising them rearwardly, but at the same time for the power engagement of the wheel with the shoes. The weight of the vehicle bears directly on the top of the shoes, upon which the wheel will revolve without any sliding action, and the whole traction strain is supported by said couple and by it alone. We are obliged to omit various constructional features which have contributed to the practical success of the system. The advantages claimed for the system include the following:

It is applicable to all kinds of wheels, whether driving wheels or combined driving and steering wheels. Given the simplicity, ease and rapidity with which the device can be put on and removed, all motor vehicles will be able to use their highest speeds on ordinary roads, and at the same time will have at their disposal an apparatus which insures perfect adhesion and allows them to travel and work, away from made roads, upon the worst and most irregular ground. The motive power is used to the maximum degree, partly owing to the perfect adhesion of the driving wheels, and partly because the running loss is limited, whatever the ground may be like, to the gliding of the trunnions against the edges of the suspension holes. The use of the device reduces the wear of the rubber tires to a minimum, as they roll easily, and without slipping, upon the metallic surface of the shoes.

To Disinfect East India Hides

AMERICAN tanners using British Indian hides and skins, reports Vice Consul Hooker at Madras, will be interested to learn that the installation of a hide and skin disinfection plant in Madras is contemplated by a native concern. The proposed plant will be equipped to handle about 2500 skins per day. The enterprise when in operating order should considerably simplify and facilitate the direct shipment of raw stock from southern India to the United States.

Elevation and Range of British Naval Guns

Main Armament of Capital Ships Remains Today as Originally Designed and Constructed

By Hector C. Bywater

THE MILITARY value of high elevation in the turret guns of battleships is a subject on which considerable discussion has taken place in the United States during recent months. Public interest was first attracted to this question by positive statements, apparently emanating from the Navy Department, that British battleships of the post-Treaty fleet had, on the average, a higher angle of gun elevation than American ships, in consequence of which the former were able to outrange the latter by several thousand yards. This superiority of range on the part of British ships was due, it was alleged, to alterations made in their turret mountings since the war, or at any rate at some time subsequent to their original entry into service. On the strength of these reports Congress was requested to appropriate funds for modernizing the United States battle fleet, and particularly its turret gun mountings, with a view to enabling the ships to use their artillery at maximum range, thus annulling the advantage which the British fleet was supposed to have in this respect. After the money had been duly appropriated, the British Government announced, through the usual diplomatic channels, that no alterations of the character indicated had ever been made in the turret mounts of any ship of the Royal Navy since its completion. This categorical denial was at once accepted by the United States naval authorities, the courteous tone of Acting Secretary Roosevelt's retraction being much appreciated in England. Apparently, however, a conviction still prevails at the Navy Department that the shooting range of the British Fleet is higher than that of the United States Fleet, and accordingly it has been proposed to carry out the plan of enlarging the gun elevation of 13 ships, viz., "Florida," "Utah," "Arkansas," "Wyoming," "Pennsylvania," "Arizona," "Oklahoma," "Nevada," "New York," "Texas," "Mississippi," "Idaho," and "New Mexico."

IN OUR April issue we exposed the falsity of the propaganda which stated that the navies were not scrapping the ships required to be destroyed by the Washington Naval Treaty. We showed that Great Britain, alone, had scrapped the eighteen dreadnaughts condemned under the Treaty and also in the four years since the Armistice had destroyed, voluntarily, a fleet of some 640 battleships, cruisers, destroyers and other auxiliary vessels. And now, from the same source, comes the statement that perfidious Albion has been surreptitiously elevating the guns of the battleships allowed her by the Treaty, with the result that the United States Fleet is today hopelessly outranged. Mr. Bywater's article shows that nothing of the kind has been done; the guns remain as they were built. In an engagement, the superiority of range would at the outset be with us, because of the 34,000-yard range of two of our 14-inch gun battleships. Then the advantage would pass to her; since, with superior speed, she could hold a controlling range of 23,800 yards.—THE EDITOR.

It may therefore not be inopportune to outline some of the technical aspects of this question as seen from the viewpoint of a British naval student. Obviously it would be desirable to give all main battery guns the extreme limit of elevation practicable; *i. e.*, the 42 deg. or 43 deg. equivalent to maximum range in most cases, if this could be obtained without corresponding disadvantages; but it cannot. Compromise is necessary, and the following remarks convey an idea of the factors governing this compromise:

To glance first at earlier times: In the prolonged naval wars with France, Holland and Spain, the truck guns carried in the British fleets were given a maximum elevation of 10 deg. to 15 deg., and a search through the archives reveals no complaint that this limit was insufficient. A larger elevation would have involved a deeper gun-port, or else the gun muzzle would strike the top sill on recoil. A lower elevation was unacceptable for another reason. In the course of the famous English manœuver, the attack from windward, their ships were all listed by the wind toward the enemy. This circumstance greatly favored the speed with which a broadside could be fired, since the heeling over of the ship provided a natural "ramp" or incline which checked the recoil of the guns and accelerated their running-out after loading. The enemy ships, on the contrary, suffered from the corresponding disadvantages. And, in the case of the French fleets, a further cause of inferiority resulted from their tactical policy; for whereas the English fired low, so as to damage the enemy's hull, the French generally fired high in the hope of dismasting their opponent. Both sides therefore required a certain elevation for their guns, but the French more than the English.

When, about the middle of the nineteenth century, the power of ordnance became too high to be controlled in truck carriages, slide mountings were introduced; the gun, on recoil, ascended a fixed sloping path and thereby expended the energy of its recoil. But great difficulties were experienced in controlling this recoil. If fired at too low an elevation the gun ran up too violently, while if fired at a high angle the downward blow on the slide was excessive. The steeper the slide, and the higher the maximum elevation of the gun, the more dangerous the blow became and the less distance the gun recoiled. Eventually it was found necessary to limit the incline of the slide to 15 deg., and the elevation of the gun to 15 deg. also. The above system was superseded, as the power of ordnance further developed, by the great Elswick invention of the hydraulic recoil-buffer, which allowed the gun to recoil axially whatever its elevation. This system permitted of high elevations, which some naval officers thought desirable. When the British fleet went up the Dardanelles during the Russian crisis of 1878 there was not a single gun which could bear on the Turkish batteries, and it was fortunate for the fleet that no hostile demonstration took place. Some years later the Elswick firm designed turrets whose guns had 40 deg. elevation, and several of these were supplied to the Italian Navy.

But official naval opinion was in all countries opposed to accepting certain positive disadvantages for the sake of obtaining high-angle fire. The chief disadvantage was one which had operated in all stages of artillery development, with the truck gun as well as with the turret, viz., the necessity for a larger gun port. In a turret the guns project through thick armor walls, and to allow them to be elevated and depressed large elongated holes have to be cut, leaving unprotected gaps. The higher the range of elevation, the greater these gaps must be; and although they may be covered or filled by screens or sliding plates of armor, they still remain as highly vulnerable patches, "weak joints" in the armor of the gun turret. How to minimize the effect of these gun port gaps is one of the problems of the turret designer. In United States ships the trunnions are usually placed close to the front sloping armor plate. With the exception of Germany, no nation before the war paid any particular heed to this feature of maximum elevation, and even in Germany's case the interest was but transient. The turret guns of her battleships and armored cruisers of the pre-dreadnought era had unusually high elevation, 30 deg. at least, which probably gave them an exceptionally long range for their power. But when the first German dreadnoughts came to be built, their turret guns were given a maximum elevation of only 16 deg., nor was this exceeded in any of their later ships. When going over the German battleship "Baden" after she had been surrendered three years ago, I was surprised to find that her 15-inch guns could not be elevated above 16 deg. This disproved the reports which had been current during the war, that our ships were invariably outranged by the enemy owing to the superior elevation of his guns; the real truth being that in the Jutland and the Dogger Bank actions our heavy guns opened fire at ranges at which the Germans could not reply.

The almost universal disregard of high elevation before the war was due to the fact that in improving the hitting power of heavy projectiles all navies were incidentally developing ranging power to an extent which was thought to be far beyond the scope of accurate fire. Battle ranges were always thought of as within the 12,000-yard limit, and as most modern big guns gave this range with a small elevation, there seemed no necessity for a greater one. The old maximum of 15 deg. was accepted as a standard.

No mystery has ever been made about the maximum elevation of British naval guns. The battleships of the "St. Vincent" class, built in 1908, which first carried the powerful 12-inch Mark XI 50-caliber guns, attained a range of over 20,000 yards with their extreme elevation of 15 deg. With the adoption of the 13.5-inch gun for the "Orion" class, with a lower muzzle velocity, it was evidently found necessary, in order to maintain the required standard range, to provide for an elevation of 20 deg. This maximum angle was maintained when changing over to the 15-inch caliber, mounted in the "Queen Elizabeth" class, and with it an augmented range of over 24,000 yards was achieved. Then, during the early days of the war, the value of very high range in special circumstances was demonstrated. At the Dogger Bank action firing began at 19,000 yards; at the Falkland Islands battle the Germans gambled on getting a hit at 21,000 yards. Presumably for this reason it was decided to give the guns of the four new battle cruisers of the "Hood" class a 30-deg. elevation, corresponding to 30,000 yards. This was done; but as, at the armistice, three of the four new ships were scrapped as they lay on the stocks, only the "Hood" herself remains, carrying guns identical with those of the "Queen Elizabeth," but with the enhanced range due to 30-deg. elevation. No alteration has been made in any other British gun turret.

In the "Hood," therefore, disadvantages have undoubtedly been accepted to obtain the extra 10-deg. elevation, and it may well be questioned whether the gain compensates for them. It is obvious that, as each gun and its mount sweeps through an extra 10 deg., a deeper turret has to be provided. A longer elevating screw or cylinder is necessary, as also a larger gun port and larger sight holes. Extra power is needed to ram the heavy projectile up a steeper incline when loading at 30 deg., and to close the massive breech—difficulties which would not, of course, arise in the case of American guns, which are understood to have fixed-angle loading. And extra stiffening may have to be provided to take the greater

(Continued on page 71)

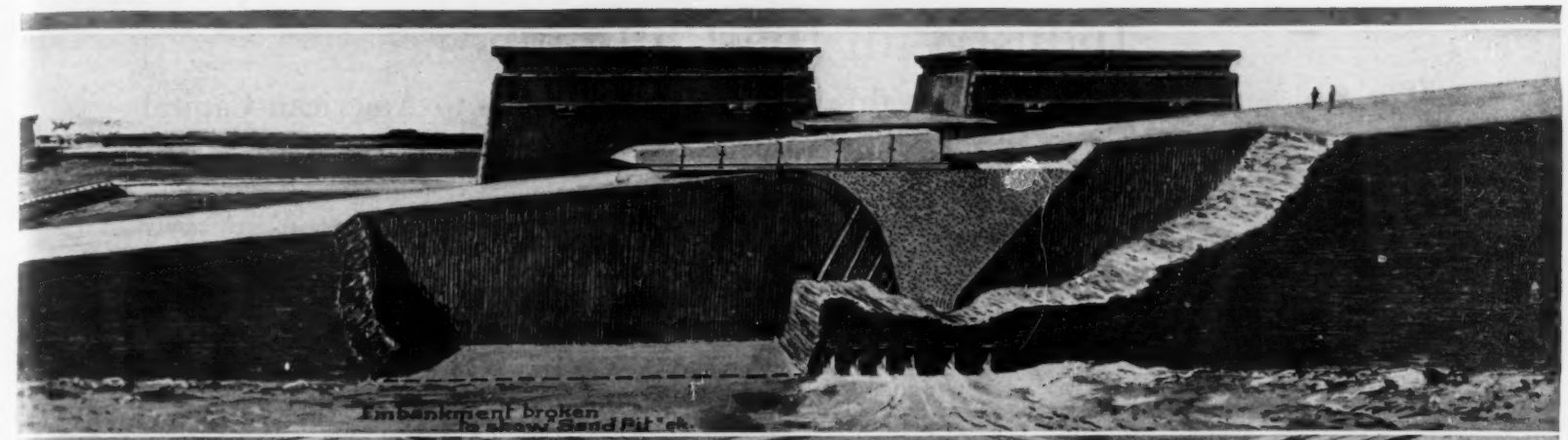
ELEVATION AND RANGE OF UNITED STATES AND BRITISH GUNS

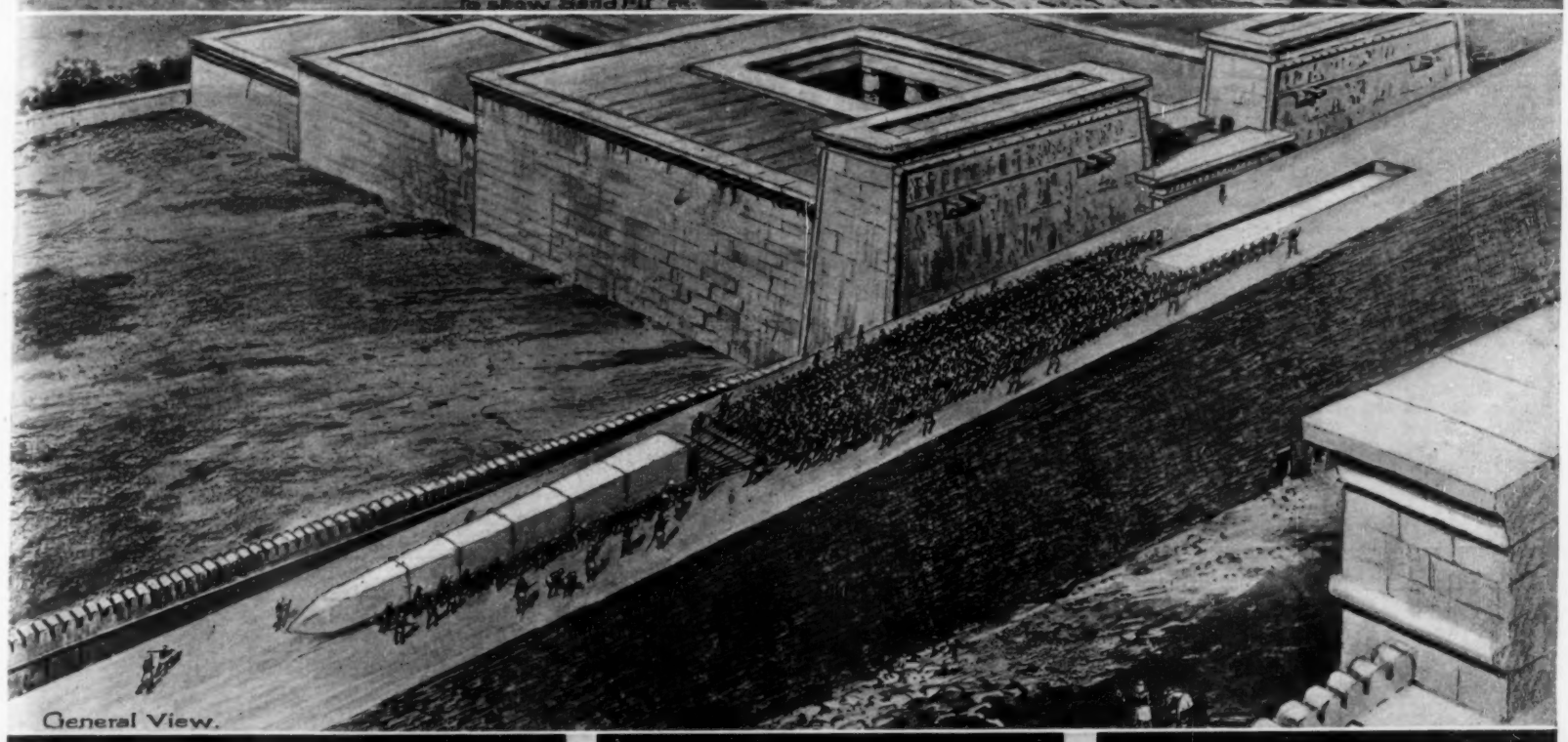
U. S. NAVY

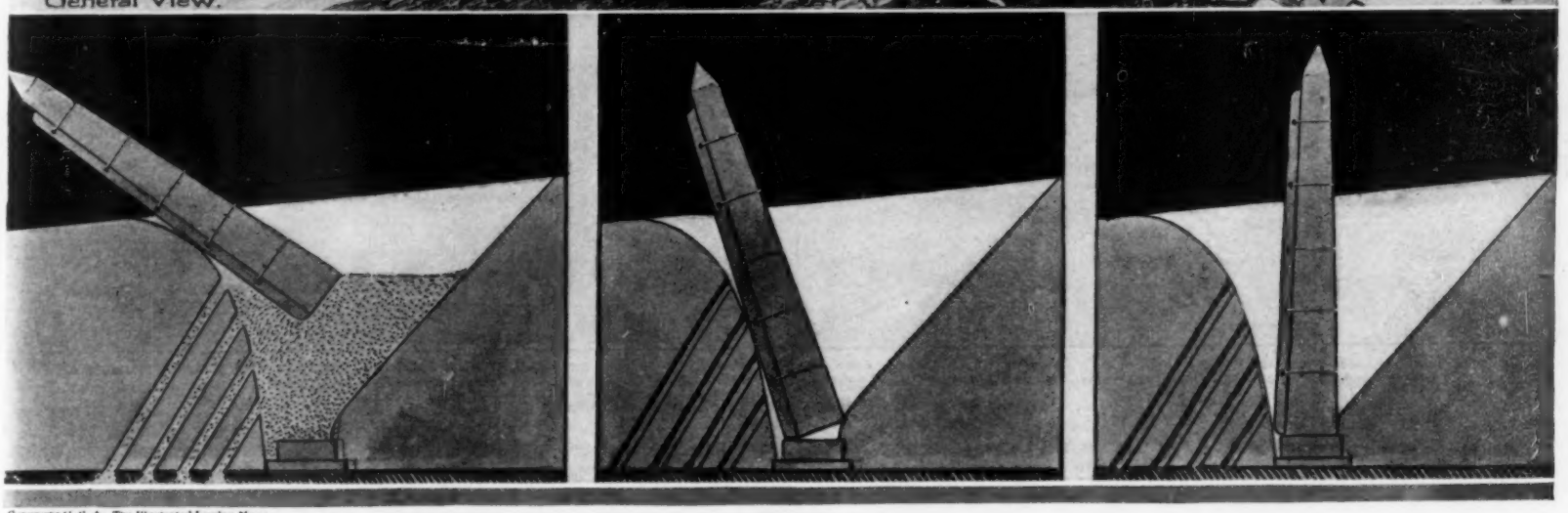
No. of Ships	Caliber of Guns	Length of Guns in Calibers	Elevation of Guns in Degrees	Normal Range
3 Battleships	16″	45	30	32,000
2 Battleships	14″	50	30	34,000
3 Battleships	14″	50	15	22,000
6 Battleships	14″	45	15	20,000
2 Battleships	12″	50	15	22,000
2 Battleships	12″	45	15	20,000

BRITISH NAVY

2 Battleships	16″	42	30	32,000
10 Battleships	15″	42	20	24,300
4 Battleships	13.5″	42	20	23,800
1 Battlecruiser	15″	42	30	30,100
2 Battlecruisers	15″	42	20	24,300
1 Battlecruiser	13.5″	42	20	23,800




General View.



THE question of the mechanical means by which the ancient Egyptians set up their huge obelisks, often in a court shorter than the obelisk itself, has long been a mystery. Cleopatra's Needle is 68½ feet high, 8 feet wide at base, and weighs 180 tons. An Egyptian obelisk now at St. John Lateran in Rome is 105 feet high, 9 feet wide at base, and weighs 450 tons. Still more enormous is the obelisk, never raised, which was recently unearthed lying horizontally in a granite bed at Assouan. It is 133 feet long and 14 feet wide at base. Its weight is carefully estimated at 1168 tons.

It has remained for the Chief Inspector of Antiquities in Upper Egypt, Mr. R. Engelbach, to suggest the above solution of the obelisk-raising problem, based on references in Egyptian papyri to a sloping brick embankment or ramp 400 yards long by 35 yards wide, and the use of sand in making it; also to the known use of levers and rollers, ropes, and the employment of thousands of slaves. The obelisk was not raised, but lowered into a funnel-shaped sand-pit dug in the ramp over the spot where it was to stand. It was hauled up the ramp on rollers until its base lay over the sand-pit. The sand was then gradually withdrawn through channels below, and as it ran out the obelisk sank into the requisite vertical position. The three lower diagrams indicate, in the order shown, the sand being removed from the pit, then the obelisk coming to rest, and lastly the obelisk pulled upright. This ingenious engineering idea may be typical, after all, of how the Egyptians carried on much of their remarkable construction work.

OBELISK-RAISING EXPLAINED: HOW THE ANCIENT EGYPTIAN ENGINEERS EMPLOYED A SLOPING RAMP AND A SAND-PIT

Industry in the Philippines

The Golden Opportunity Which this Dependency Presents to American Capital

By Vicente Villamin

THE ECONOMIC progress of the Philippines since American occupation 23 years ago far surpasses that of the three centuries preceding it. It is marked by extension of operations, greater and more standardized production, modernization of processes and more coordination in management and marketing. The development of the country on a larger scale is a challenge to enterprise.

There are 7000 islands in the Philippine group, which fact makes water transportation vital. There are 6000 miles of good roads, 9000 miles of telegraph lines and 900 miles of inter-island cables. Distant points in the archipelago are connected with Manila by radio. The outside world is reached by three cables and one wireless system. There is a tonnage of 1,300,000 engaged in ocean shipping; while the aggregate of entrances and clearances in the coastwise service is 2,000,000 tons. The foreign trade totals $250,000,000 yearly and the domestic business amounts to $900,000,000. The archipelago has an area of 115,000 square miles with a population of 11,000,000. The total wealth of the country is estimated at $5,500,000,000.

The Public Utility Commission has jurisdiction over three railroad systems, one street railway, one gas plant, 54 electric plants, eight water systems, forty telephone systems, two telegraph systems, 24 public wharves, 484 automotive vehicle lines and 138 steamers and steamship lines.

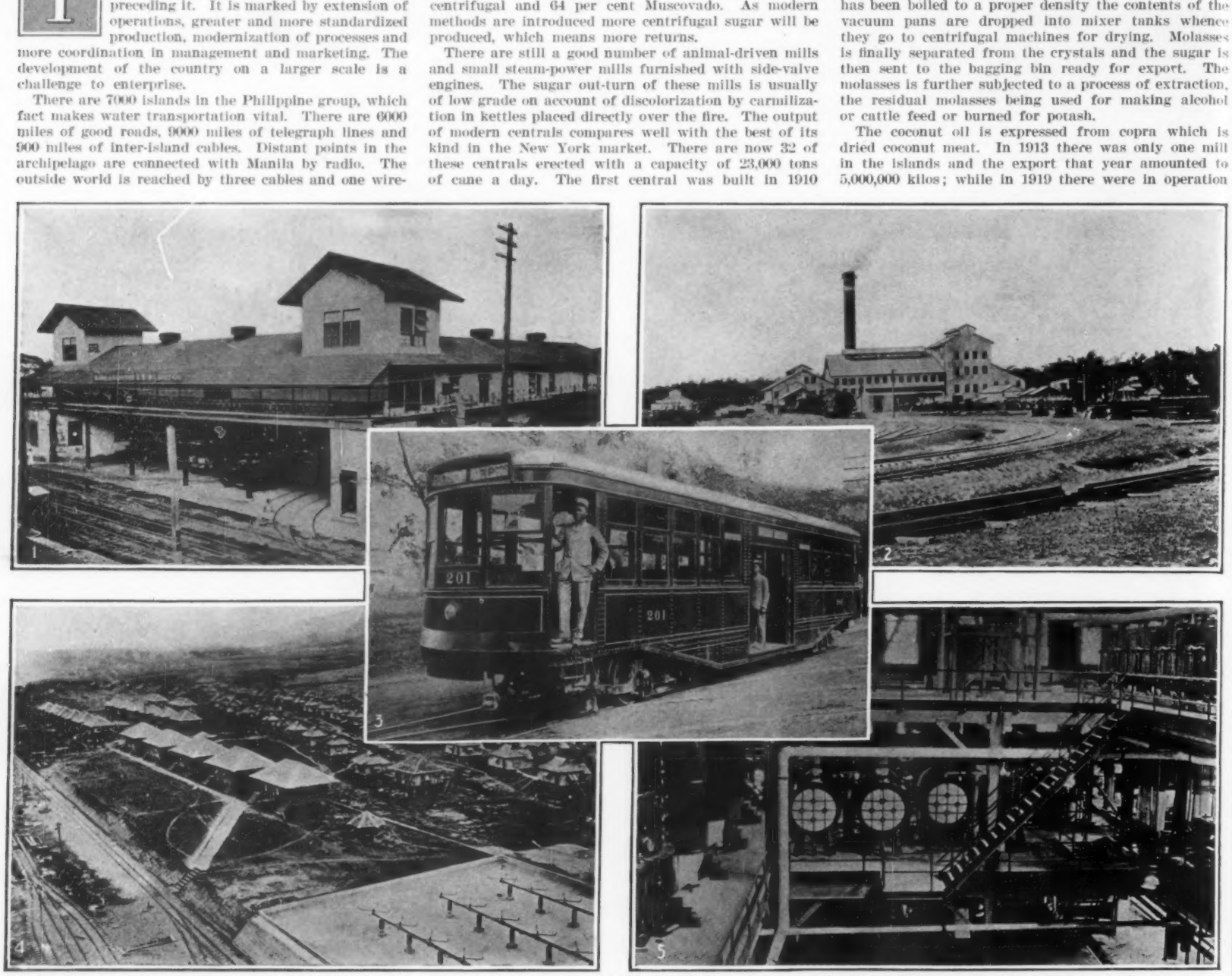
The first sugar shipment was made in 1795 when about 300,000 pounds were shipped to the United States. Development of this industry is steady but rather slow, principally due to limited capital. In 1900 the export was 65,000,000 kilos; in 1922 it was over 300,000,000 kilos. In 1920, 21 per cent of the sugar produced was 96 degrees centrifugal and 79 per cent 88 degrees Muscovado; in the following year it was 36 per cent centrifugal and 64 per cent Muscovado. As modern methods are introduced more centrifugal sugar will be produced, which means more returns.

There are still a good number of animal-driven mills and small steam-power mills furnished with side-valve engines. The sugar out-turn of these mills is usually of low grade on account of discolorization by carmilization in kettles placed directly over the fire. The output of modern centrals compares well with the best of its kind in the New York market. There are now 32 of these centrals erected with a capacity of 23,000 tons of cane a day. The first central was built in 1910 on the island of Mindoro. The first shipment of centrifugal sugar, however, was made in 1914 from the San Carlos plant.

The cane goes on an endless moving platform into the crusher provided with rollers; from here the mat of cane passes to the milling plant proper consisting of a series of roller mills set in tandem. The cane fiber is then macerated by the application of water to obtain the maximum sucrose extraction, the fiber passing from mill to mill during this process. The juice obtained is subjected to a process of clarification. After being treated with milk lime to neutralize the acidity it is discharged into settling tanks to remove impurities and then decanted into the evaporator supply tank and from there pumped into cachaza tanks whence it is again decanted and discharged into filter presses. The clarified juice contains about 85 per cent water and 15 per cent solid matter. About 75 per cent of the water is removed by multiple-effect evaporators, which discharge the syrup into vacuum pans where it is boiled into crystals. Impurities remain in the mother liquor and are carried off as molasses. When the massecuite has been boiled to a proper density the contents of the vacuum pans are dropped into mixer tanks whence they go to centrifugal machines for drying. Molasses is finally separated from the crystals and the sugar is then sent to the bagging bin ready for export. The molasses is further subjected to a process of extraction, the residual molasses being used for making alcohol or cattle feed or burned for potash.

The coconut oil is expressed from copra which is dried coconut meat. In 1913 there was only one mill in the islands and the export that year amounted to 5,000,000 kilos; while in 1919 there were in operation 43 mills equipped with 296 expellers and 225 hydraulic presses from which 140,000,000 kilos of oil were shipped abroad. This material goes to the soap, margarine and compound lard industries, displacing in a great measure fats and certain vegetable oils.

After disintegrating the copra it is passed through grinders where it is converted into meal which then passes to the dryer where it is moved on belts under 220 deg. Fahrenheit for about 40 minutes, all surplus moisture escaping in a continued draft. The meal then finds its way into the oven for further tempering or cooking, being subjected here to a dry heat of about 150 deg. for 20 minutes or so, at the end of which time it goes to the expellers where it is ground by spiral screens at thousands of pounds of pressure to the square inch. The oil, laden with impurities, flows off to receptacles whence, after segregating foreign matter, it goes to filtering tanks for further clarification. From here it goes to storage tanks ready for shipment in deep



1: Car-house and main office building of the Manila Electric Company. 2: A typical sugar central in Luzon. 3: The current style in trolleys in Manila. 4: The laborers' quarters and (right foreground) the spray pond on a large sugar central. 5: Settling tanks, juice heaters and evaporators which constitute part of the machinery of sugar-cane reduction

Glimpses of the industrial life of the Philippines

sea tanks. The most important by-product of the oil is the meal which contains about 5 per cent of oil and is utilized for cattle feed in America and Europe.

The Philippine copra industry is quite important. There are 83,500,000 coconut trees, of which over 47,000,000 trees are in bearing, yielding annually about 1,500,000,000 nuts. In 1921 the copra production consisted of 181,000,000 kilos of sundried, 193,000,000 kilos of smoked and 1,000,000 kilos of steam-and-hot air dried. Improvement in the copra drying process is badly needed to place Philippine copra on a competitive basis with that produced in neighboring countries.

A profitable industry can be developed out of the husks of the coconut, estimated to be 100,000 tons a year, for making coir mats, binder-twines and allied manufactures. Coconut shells make fine charcoal and were used in the fabrication of gas masks during the war.

An industry which is hardly two years old is the desiccated coconut used in the confectionery manufacture. America alone imports about 40,000,000 pounds a year. This commodity is protected by a high tariff.

Hemp made Manila famous. The hemp (*musa textiles*) is a perennial plant and is the most important endemic in the Philippines. The country has a natural monopoly on it, the hemp transplanted with the greatest of care in other tropical regions having produced only inferior and weak fiber. Hemp was known as cordage article in 1820 when an American naval vessel took a shipment of it back to America. Although it was locally known for centuries it was not until 1840 when it became an international article of commerce. In 1921 over 141,000,000 kilos were exported.

The stripping is done by hand with the aid of a simple apparatus invented by a Spanish priest in 1810. A great number of stripping machines have been invented and proved successful in the laboratories but found unsatisfactory for the economical extraction of the fiber under field conditions. The fibers are the fibro-vascular strands of the sheathing leaf-stalks that make up the trunk. After slitting the fiber-producing portion of the tree into strips, these are pulled under a knife applied to a wooden block. The condition of the knife blade, the pressure with which it is pressed and the method of drying are the most important factors that determine the color and strength of the fiber.

A tree produces a little over a pound of dry hemp. Two men devoting four days in stripping and tree cutting and two days in weeding and cleaning the plantation can make about 75 pounds of the best grade of hemp a week and about 150 pounds of the lower grades. The workers are generally also engaged in other callings.

Hemp is both acid- and salt-resisting and by reason of the fact that it is the strongest of hard fibers it is intrinsically worth more than what it fetches at the world's markets. It is used for marine rope, towing rope, transmission rope, oil-well cables, lariats, fine grades of binder-twine and allied products. The waste grades are manufactured into paper in Japan. A small fraction of the hemp is made into tagal braid for hats and trimmings, and in the Philippines the fiber is used in making cloth, hats, baskets and many other articles. The rope-making industry in the country has been started. In this industry one big failure has already been registered.

A COUNTRY of 115,000 square miles and eleven million people, against Cuba's 44,000 square miles and three million inhabitants; yet with its resources so untouched that its total foreign commerce in its most prosperous year was but 270 million dollars, against 820 millions for Cuba in the same year—that is the Philippines. Its climate and soil quite as well suited to sugar-growing as those of Cuba, and in addition equally advantageous for the cultivation of rubber; its forests and mountains constituting a store-house of timber and mineral wealth of which Cuba could never have dreamed —this is the country whose exploitation the present author urges upon us as worth while. Can we do other than agree with him?—THE EDITOR.

The tobacco industry ranks fourth among the wealth-producing activities in the Philippines, with a future that outranks all. The tobacco seeds were introduced by Spanish missionaries from Mexico in the sixteenth century. In 1781 the Spanish Government established a monopoly which lasted a century. The first Manila cigars arrived in America in 1818 when an American wind-jammer, the "Pequot," reached Salem with a story of an engagement with Chinese pirates which brought the ship to Manila. The industry is well organized and firmly established. In 1900, 173,000,000 cigars were exported while in 1920 the number was 421,000,000. The production of cigarettes is 5,500,000,000 yearly. The area planted to tobacco is 91,000 hectares yielding about 53,000,000 kilos of leaf tobacco. This acreage is 39.4 per cent greater than the five-year period of 1915-1919 and 46.9 per cent than the period of 1910-1914. The land available to tobacco growing is extensive. The tobacco area is inundated yearly by the Cagayan River which obviates the necessity of artificial fertilization.

The fabrication of cigars is done by hand. Over 10,000 men and women are employed in the cigar factories of Manila, which look like palaces. The outputs of different factories are standardized, especially as to quality, the Government exercising the closest supervision in the factories. Applicants for work in the cigar factories undergo physical examination and employees are regularly examined; the least sign of ailment is enough for the employee to be barred from the factories until he or she gets perfectly well. The trade in America concedes without cavil that Manila cigars are the best moderate-priced cigar in the market, and for this the close supervision is largely responsible.

The tobacco leaf from the plantation is put through a process of curing which takes about three years, at the end of which period the tobacco is sterilized. It is then loft-dried and put through another curing process which lasts about four months. With the exception of the stripping machine no machinery is used. It is not permissible to use molds, and the system of "team work" and the use of "suction tables," which accelerate production at the expense of quality in other countries, are not known in Manila factories. Manila cigars are of clean whole tobacco; even the cheapest kind are long fillers. Scrap tobacco is manufactured into cigarettes and the rest exported.

THE prosperity of the Philippines, Mr. Villamin tells us, is yet to be realized. A billion-dollar trade with the United States is the aim of his compatriots. As soon as the needed capital comes and the staple industries are developed, especially those of rubber and sugar, Mr. Villamin feels that his native land will become one of the most important factors in world trade. And his rather imposing list of Philippine industries that hold out hope for large expansion seems sufficient to justify this optimism. —THE EDITOR.

The commercial forests occupy about 60,000 square miles. Three kinds of lumbering are in vogue: hand-sawing, water or steam mills and large steam mills, both band and circular types. American machinery and equipments are being used in an increasing degree. The industry is strictly in its infancy. The United States market is just getting acquainted with Philippine woods; in 1921 about 24,000 cubic meters of wood were sent abroad. By actual comparative analysis the hardest and softest woods are found in the Philippines. There are varieties that make excellent railroad ties; one of them, the Ipil, has an average life longer than any creosoted tie known. The lumber industry is receiving considerable attention and promises to be one of the leading industries of the country before long. Measures against deforestation and conflagration are enforced strictly. Lumber exports are passed upon by Government experts.

Embroidery and hat industries are done by hand and exhibit the infinite patience and dexterity of hand of the Filipinos. Although only half a dozen years old the embroidery industry is now worth over $7,000,000 a year, the United States market absorbing the big bulk of the output. This industry is a home industry, companies located in the city of Manila distributing materials among workers in their homes in different towns and maintaining a corp of men to gather finished embroideries. Cloth is brought over from the United States, sometimes already cut up and marked, for embroidering. The industry is fast developing, and considering the number of potential workers all over the Philippines, almost every woman being skilled in the work, the future of it must be limitless. The hat industry is also a home industry and is wholly done by hand work. Straw hats are made out of buri, bamboo, grass and reeds and grass.

Experts have declared that the biggest gold dredging area and the richest placer grounds combined with the easiest methods in the world are located in the Philippines. One of the dredges during four and a half years' operation averaged 37 cents a yard for every yard handled, which beats all the known record anywhere. American equipments are exclusively used. Mining and dredging companies in different parts of the Islands report progress and prosperity. Silver, copper, iron and other mineral deposits are known to exist and are receiving increasing attention. Asphalt is already exported, mostly to Japan. Coal is being mined and it is stated that before many years the country will stop importing coal. Cement plants are working and quality of output is very encouraging. Several mineral oil wells have been sunk, high quality oil has been found, but the matter of its commercial exploitation is still under consideration. There are large fertilizer deposits, and a couple of asbestos works are producing fair quality materials.

The rubber-growing industry is an infant one. Comparative figures are very illuminating. The costs per acre of rubber lands are: Philippines, $51, up-keep cost, $20; Sumatra, $110, up-keep cost, $23; Java, $138, up-keep cost, $29. Conservative estimates of yield are: 0.60 pounds for four-year old trees; 2.91 pounds for eight years; and 6.22 pounds for 12 years. The Hevea rubber is what has been found to grow most advantageously in the country. The rubber acreage is very small, although the acreage suitable for rubber-growing is extensive. There is a strong movement in America to grow all its rubber requirements in the Philippines. The industry is valued around $250,000,000 in the primary markets.

Mangrove trees yielding 30 per cent of tannin grown wild in innumerable numbers in swamps. Papain from papaya trees is obtainable which in color and activity is equal to the best in the market. There are recognized about half a dozen plants as sources of medicine in standard pharmacopoeia. St. Ignatius bean yielding strychnine and brucine is grown only in the Philippines, while datura that yields atropine grows luxuriantly. Castor oil plant, croton oil plant, kamala and other plants of purgative properties grow almost in a wild state. Chicle, now imported from Central America, is obtainable in the Philippines in great quantity. The United States imports 8,000,000 pounds of this a year.

One great industrial opening is the manufacture of paper pulp for which the raw materials are plentiful, among them being bamboo, cogon grass, abaca wastes and various palm trees. There should be a good future for bamboo soda pulp. Starch-producing plants like cassava, arrowroot, sincamas and yams grow everywhere. Materials used in the paint and varnish industry, like copal, elemi and other terpen-producing plants, abound. Already there are being manufactured high-grade perfumeries from ylang-ylang, champaca, vetiver and lemon grass. There is a nucleus of 40 hectares of mulberry trees yielding silk which compares well with the Chinese product in quality. There is now much excitement over this industry which is believed to be another bonanza. Maguey fiber, of which there is quite an exportation, and rattan and willows are being developed rapidly. The growing of peanut for oil has received great impetus by the steep raise of the tariff on it from foreign countries in the United States.

The waters of the Philippines teem with fish, corals and shells. There are some 50 pearling boats, mostly Japanese, engaged in the pearl fisheries. The Sultan of Sulu and other Moro dignitaries are known all over the world as the possessors of beautiful pearls obtained around the waters of the island of Mindanao. Soon the Philippines will not import sardines. Anchovies, sardines and the most variegated fish abound undisturbed in big schools in the limpid waters of the Philippines. Shells for pearl buttons are exported to the extent of 700,000 kilograms a year.

The pastoral industry is not as important as it should be, there being only 1,600,000 carabaos, 800,000 cattle, 300,000 horses, 3,700,000 hogs, 800,000 goats and 200,000 sheep. Communicable animal diseases are prevalent all the year around. They are being combated vigorously and are under control. Queerly enough the country has to import about 6,000,000 dozen eggs a year from China, and $5,000,000 worth of dairy products from America and Australia. Cattle-raising should be one of the important industries of the country.

The alcohol industry (the Eighteenth Amendment is not applicable to the Philippines) is quite important. It is mostly manufactured from the sap of the nipa palm, coconut tree and sugar molasses. There are around 90 registered stills producing about 10,000,000 proof liters a year. There are two big breweries producing around 5,000,000 gage liters of beer a year. Over

(*Continued on page 71*)

Using oil to rout the mosquitoes from the rock pits, their favorite breeding grounds

Fighting the Mosquito

How Minnows, Oil, and Drainage are Freeing Florida of a Leading Enemy of Immigration

By D. H. George

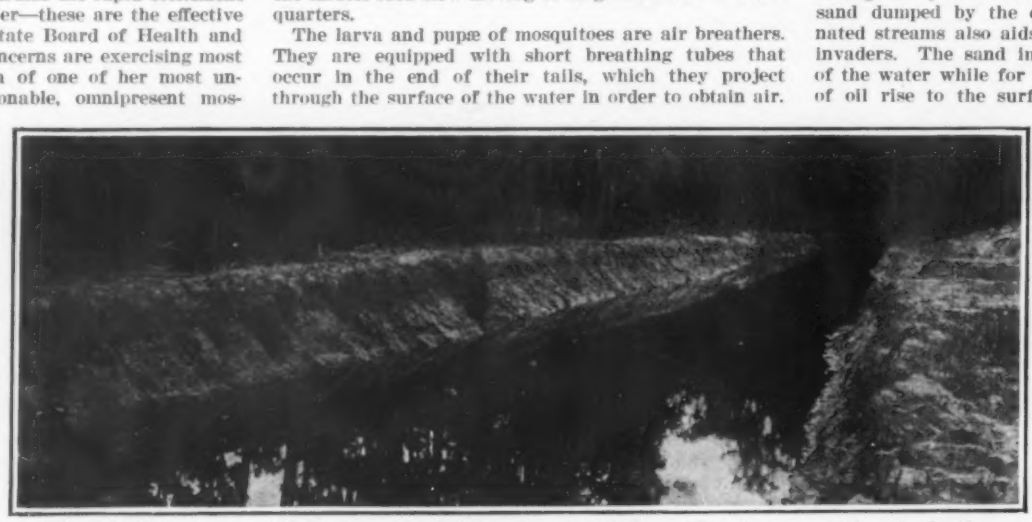
USING minnows as mosquito policemen, digging huge drainage ditches that cost from $30,000 to $50,000 apiece, fighting the minute parasitic pests with oil and State-wide cleanup activities, mobilizing every agency of modern science to eliminate a menace and peril which jeopardize the rapid settlement of the land of our last frontier—these are the effective measures that the Florida State Board of Health and manifold civic and private concerns are exercising most vigorously in freeing Florida of one of her most unwelcome guests, the objectionable, omnipresent mosquito, the minute musketeer of the insect world who delights in poking his prickly bayonet into human flesh. Throughout Florida, the lowly mosquitoes that breed and swarm over regions of stagnant water have for many years acted the rôles of winged "Shylocks," ever voracious for their tribute of blood. Floridans have now arisen and united resources in the most determined campaign against the pestiferous "bloodsuckers" ever waged in Dixie.

The mosquito as an enemy to immigration and settlement and to sanitation and health is going to be eradicated from the land of flowers and winter sunshine before the armaments of science are again set aside. Florida has initiated a State-wide drive which will cease only when the winged stingers that have been a source of disease and menace have been permanently put to flight. Although at least 40 of the 500 known varieties of mosquitoes breed abundantly within the borders of Florida only four of them are feared as obnoxious carriers of disease. Of this quartet of miscreants, the mosquitoes known scientifically as the aedes tribe are the most objectionable, being the active disseminators of dengue fever—a malady which made temporary invalids of at least 20 per cent of the population of the southern States except Virginia and North Carolina last year. The disease is not fatal but it enervates and weakens the patients and markedly reduces their economic accomplishments.

This same aedes mosquito is a virulent carrier of yellow fever in addition to being a foe of immigration. That is why all of Florida is now aroused and enrolled in a bonanza campaign to rout the pest. The average mosquito is a semi-nautical maritime insect in that the minute fly cannot come into existence without water in which its various stages are passed. Hence the leading control measure is to eliminate the water-logged haunts and dens where mosquitoes may breed. In a State like Florida which has more than 30,000 lakes and a coast line that covers more than 1200 miles, it appears to the layman impossible to control mosquitoes by eradicating such favorable breeding grounds. Experts report, however, that by practicing such controls in the vicinities of cities the extensive disease and havoc wrought by the pestiferous fliers can be controlled practically. The distance that mosquitoes will fly from their place of origin depends largely on wind and weather conditions. In the brackish water sections of the Everglades, they have been found in large numbers inland 20 to 30 miles from the coast while in New Jersey, the busy biters have been discovered as far inland as 40 miles from the coast.

Mosquitoes breed in any standing water, even that in buckets or rain barrels which are often found in the neighborhood of human habitations. The female deposits from 200 to 400 eggs at a time, which hatch out in from 20 to 48 hours. Generally speaking, from 10 to 20 days are required to complete the development of mosquitoes from egg to adult during the summer months. One interesting process in the emergence of the new crop of mosquitoes is the manner in which the "wigglers" use the old skins of their pupa stages as rafts upon which they float about until they can stretch out their wings and fly away. If there is much movement of the water in the pupa stage, the mosquito will drown. That is why the insects seek slow moving or stagnant water as headquarters.

The larva and pupæ of mosquitoes are air breathers. They are equipped with short breathing tubes that occur in the end of their tails, which they project through the surface of the water in order to obtain air.



The $30,000 drainage ditch that has freed the community of Perry, Fla., from mosquito domination

This breathing method of the mosquito permits the practice of an efficient control measure which is being used largely throughout Florida. It consists in sprinkling or spraying a thin film of oil over the surface of the contaminated water. The mosquitoes are unable to push their breathing tubes through the oil film. Their air supply is thus shut off and they drown and die. The oiling system is most effective for treating small pools of water in ditches, ponds, streams, boat slips, crab holes, shallow lagoons, fire barrels and large containers of water. Oiling is a temporary measure and has to be practiced faithfully to secure desirable permanent results. The Florida State Board of Health has lined up the cooperation of all the garages in the State. These service stations save all the oil that they drain from the crank cases of automobiles and give it to the State authorities for use in eradicating the pesky mosquitoes.

According to the Floridan practices, oil is administered in knapsack sprayers, watering pots, drip barrels or cans, oil soaked sawdust or sand and by mop or burlap sticks. The knapsack spray is the most efficient and rapid distribution medium. The supply can will hold five gallons of oil. The operator works a hand pump and can shoot the oil in all directions a distance of 20 feet. The method is especially efficient in oiling the edges of ditches, streams and pools. The oil drip can, placed along the course of a stream or ditch so that oil seeps constantly in the desired amount from the can into the water, is another efficacious control. The can is usually suspended three feet above the water and the hole made large enough so that from 10 to 20 drops of oil will drip out a minute.

Sawmills are numerous throughout Florida and sawdust is easily obtainable. The mosquito fighters have worked out another novel control system by soaking one bushel of sawdust in two gallons of oil for about 24 hours. The oil saturated sawdust is then "sown" over the water as one would scatter seeds over the ground. In some cases, burlap bags of oil-soaked sawdust are anchored in the stream in such a manner that they emit a stream of oil for some time which is effective in killing off myriads of dangerous mosquitoes. Oil-soaked sand dumped by the cartload into mosquito-contaminated streams also aids in the abolition of the winged invaders. The sand immediately sinks to the bottom of the water while for several days thereafter, bubbles of oil rise to the surface, burst and spread rapidly.

The ordinary minnow is worth $1 apiece in preying on mosquitoes. The Floridans stock streams and pools with minnows and soon the finny swimmers eradicate the obnoxious colonies of mosquitoes. It is not unusual for a minnow to consume as many as 100 large mosquitoes in a single day. All that is necessary is that the water be free of lily pads, water hyacinths, matted grasses and other sources of obstruction which will prevent the minnows from penetrating to all parts of the ditch or stream.

Drainage is a permanent mosquito control measure that has proved most practical under Floridan conditions. At Perry, Fla., a community where 65 per cent of the population used to suffer from malaria, a $30,000 drainage ditch was constructed some time ago which has eliminated the mosquitoes and the source of the malarial infections. The delivery of the community of Perry from the domination of disease-spreading mosquitoes has put new life into the town and has been the commercial making of the surrounding countryside which was non-progressive during the supremacy of the mosquito monarchy.

Using the knapsack sprayer on the lawns of Miami, Fla., during the rainy season when the mosquitoes get their start. As the picture indicates, Florida's rainy season lives up to its name

Marine Wood Borers at Work

LIMNORIA is the name given by scientists to the species of marine borers to which these succulent-looking individuals belong. While the largest of these borers are only one-fourth inch long (they are shown here somewhat magnified), this rapid breeding pest is one of the most destructive of the wood destroyers found in salt water.

The *Limnoria* are found on both the Atlantic and Pacific coasts, subsisting on any untreated wood on which they may find lodgment, the piling in harbors affording one of their principal opportunities for existence. Coming in contact with the piling through chance of tide or drift and lodging on the surface or in crevices, the *Limnoria* start a system of interlaced burrows on the surface, eating away the softer springwood and leaving the harder wood in rib-like ridges. As the outer shell of the wood attacked is in this manner reduced to a spongy consistency, and is broken or washed away, the *Limnoria* penetrate deeper and deeper until in time the pile may be eaten almost through and snap off under its own weight.

Limnoria are especially hard to combat, owing to the fact that they will penetrate the impregnated portion of treated wood through the least crevice or abrasion and occasionally attack treated wood that may have leached out to a low toxicity.

The United States Forest Service and its subsidiary, the Forest Products Laboratory, are cooperating with other agencies in efforts to find effective chemical or mechanical treatment which will make piling immune to the attack of marine wood destroyers. This is one of the most interesting of the many fields of activity entered by the Forest Service in promoting timber conservation.

Shop-Made Lawns by the Yard

NO longer need the impatient golfer whose club is a newly organized one, or whose course has had to be renovated, wait weeks and months for the grass to grow to the point where the permanent greens may be used. Factory-made greens may now be bought by the yard, and laid down in their full velvety growth. The same service is available for grass tennis courts. A British "pro," J. MacDonald, of Harpenden, Hertfordshire, has perfected a method of sowing grass seed on a special fabric in a "factory" where the temperature is always that of spring or summer. Carpets of green grass are thus produced, and when these are laid down on flattened surfaces, the fabric rots away and the roots become incorporated with the soil. Lawns thus made can be played on in a very short time. Moreover, by a somewhat different method, a lawn for immediate play can be made. In this case the seed is sown into wooden trays with a fabric bottom. These can be transported in a crate and dove-tailed together, thus producing a green lawn which can even be laid down under cover. These same kind of grass rugs were employed during the World War for the camouflaging of gun emplacements and ammunition dumps.

Cutting into lengths the factory-made grass carpets for golf greens and tennis lawns

How Sharp Is a Needle?

ONE often hears the expression: "As sharp as a tack," or "As sharp as a razor," but in nature this would be a very poor simile, as evidenced in the accompanying photograph of a bee stinger in comparison with the point of a very fine needle, magnified through a microscope 400 diameters. At this magnification it will be noticed that the needle is very blunt and rounded, and quite crude as regards workmanship, while the stinger is perfectly smooth and *still sharp.* Further than this, something of the workmanship of nature will be realized by the fact that this tiny shaft is not solid, as it would appear, but contains a duct or interior channel through which the poison secretion is injected into the possible victim.

The poison is supplied from two sacks or glands. The one known as the acid gland is supposed to contain formic acid; the other sack secretes alkalin; and it is the mixture of the two which forms the poison. It is this poison secretion injected into the flesh, and not the puncture of the stinger, which causes the intense pain with which the most of us are more or less familiar.

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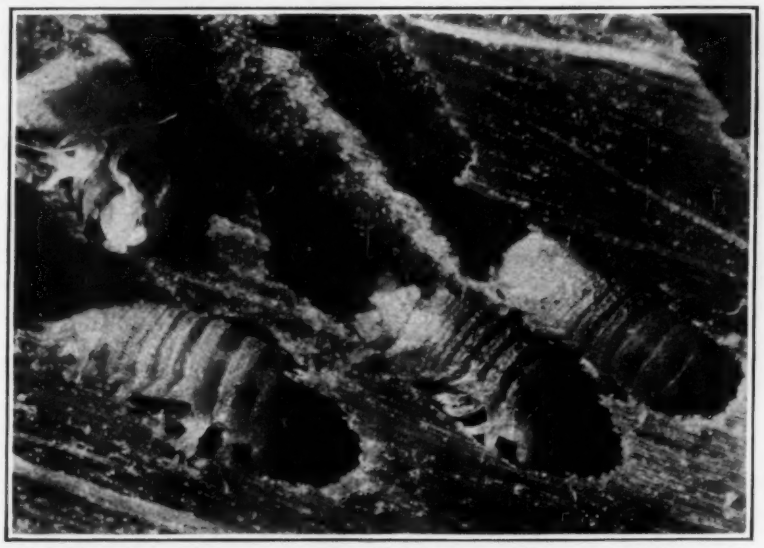
A needle point (left), and that of a bee's stinger, photographed at 400 diameters magnification to show the relative crudity of the former



The thing that makes our wharves short-lived—a colony of wood borers at work, under a magnification of about fifteen diameters

Compressibility and the Size of Atoms

ONE of the most interesting subjects discussed at the meeting of the American Association for the Advancement of Science at Cambridge in December last was that of the size of atoms, especially as they exist in solids. Only a few years ago it was believed that the atoms in solids occupy only one-fourth to one-half the total volume at any instant, but that each atom vibrates with a high frequency in the space between the adjacent atoms available for this purpose. It was supposed that in the compression of the solid the atoms are merely forced closer together, without any distortion of the atoms themselves. About 15 years ago Professor T. W. Richards of Harvard University began to develop the distinctly novel idea that the atoms occupy most of the space in a solid and that in any considerable decrease of volume the atoms themselves are diminished in size. This gave rise to his celebrated theory of "compressible atoms." In 1921 Professor Richards showed that the dimensions of atoms could be calculated from the compressibilities of the solids in which they exist, provided data are available for a set of compounds related to each other chemically in a sufficiently simple way. For example, he obtained such data for the fluorides, chlorides, bromides and iodides of lithium, sodium, potassium, rubidium and caesium. Using an ingenious extrapolation to zero compressibility he was able to show that the values correspond to a diameter of 2.8 Angstrom units (ten-millionths of a millimeter) for the chlorine atom in common salt and other similar compounds. The interesting feature of the results is that diameters of the atoms, especially those of the metals, proved to vary with the nature of the compound in which they are found. Thus the sodium atom is smaller when combined with chlorine (as it is in common salt) for which it has a high affinity, than when it is united with bromine or iodine, for which its affinity is less. Professor Richards' most recent work has been to devise a new and more directly experimental method for calculating the dimensions of atoms, with the remarkable result that the values obtained are the same, within the limits of error, as those given by the older method. The new method depends upon the idea that the element, sodium, acts under compression exactly as potassium would act under high pressure. The attractive forces between the atoms is such that the internal pressure in sodium under ordinary conditions is 20,000 atmospheres higher than that in potassium. By using the data on these two elements, he is able to show how the contraction which occurs in the formation of a salt from the elements may be distributed between them. The results throw much light upon the mechanism of chemical combination, the magnitude of the internal pressures involved and many allied phenomena.

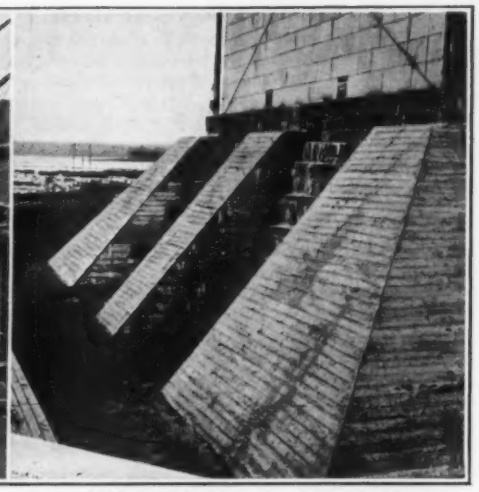
The Present Conception of Matter

IT is probable that in the stars there is going on a transmutation of the elements, more complex ones being built out of the atoms of hydrogen, the simplest of all, while others are themselves disintegrating. And what is going on spontaneously in the stars has actually been accomplished artificially in the last year or two by Sir Ernest Rutherford in the Cavendish Laboratory at Cambridge. Although, as yet, the total amounts of subatomic energy he has liberated have been minute, they are enormous when compared with the quantities of matter affected; but it must be added that there is no evidence that we may tap these stores of power.

It is for such reasons that, during the last few years, our conception of the nature of matter has entirely changed. The nineteenth century dispelled the hazy ideas of the alchemists. New elements were continually being discovered, and, the more exact investigation became, the more likely did it appear that these elements and those previously known were the ultimate materials of the universe. More than 80 elements became known. Mendeleeff had found it possible to arrange a periodic scheme by means of which undiscovered elements could be predicted to fill the blank spaces in the table, and subsequent discovery showed how accurately the properties of such elements had been foretold. Later on, Sir William Crookes thought of the evolution of the elements from a fundamental something which he called a "protyle," a hypothesis originally advanced by Prout in 1815. But with the advent of the twentieth century came the greatest change. From many sides attacks were made on the idea of the mutual independence of the elements, each of which had been supposed to possess precise and exclusive characteristics. It was shown that elements existed in which the atoms were not all exactly alike, although the different specimens of such elements were chemically indistinguishable from one another; these were named "isotopes" by Professor Soddy. Lead, for example, is one of them. This substance may be obtained in several different ways; to the chemist it is always lead, but its atomic weight depends on the way in which it has been derived.

Setting the 3300-pound capstone, Dec. 6, 1884. The staging is supported from the windows on each face

This view was taken when the surface soil had been removed, uncovering the original rubble stone foundation, preparatory to underpinning



The old foundation was cut away and concrete buttresses built in, piece-meal, without any cracking of the upper masonry

Underpinning the Washington Monument

Enlarging the Foundations to Carry the Five Hundred and Fifty-Foot Shaft

IF THE Washington Monument had been built in the days of the ancients, it would have formed, doubtless, the eighth "wonder of the world." Even today, in this age of big constructions, it stands unrivaled in the class of obelisks to which it belongs.

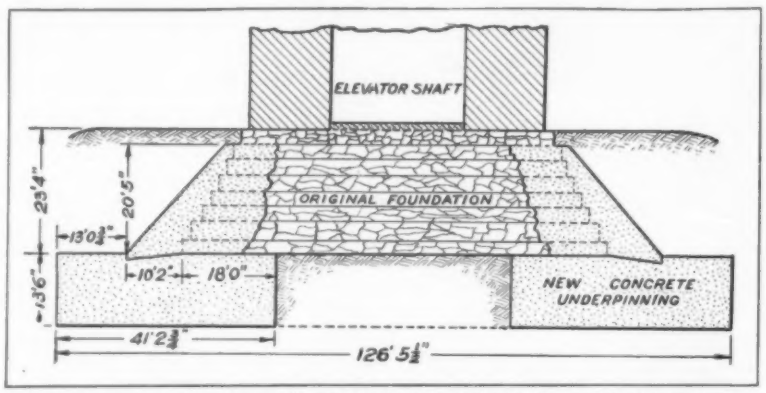
Among the millions of American citizens who have looked upon this noble memorial to George Washington, very few are familiar with the story of its erection, and we owe it to Capt. D. L. Weart, of the Corps of Engineers, United States Army, writing in the last issue of the *Military Engineer*, that the following account of the erection of the Monument had been made public. The following article is based upon his most interesting story, and to the above mentioned journal we are indebted for our illustrations.

The first movement in the direction of building a monument to Washington, was made in 1783, when the Continental Congress authorized the erection of an equestrian statue to be erected where the seat of Congress was established. In 1791, L'Enfant provided a location for the statue in his plan of the city of Washington.

Shortly after his death in December, 1799, Congress, on the motion of John Marshall, provided for the erection of a marble monument in Washington, and requested that the family permit his body to be deposited under it. The subject was brought up again in 1816, and in 1819, but nothing definite was done; although about this time a vault was prepared for Washington's remains beneath the floor of the crypt under the dome of the Capitol. James Buchanan, in 1824, and President John Quincy Adams, in 1825, brought the question to the attention of Congress; but still no action was taken. So much for the remembrance and veneration of Congress.

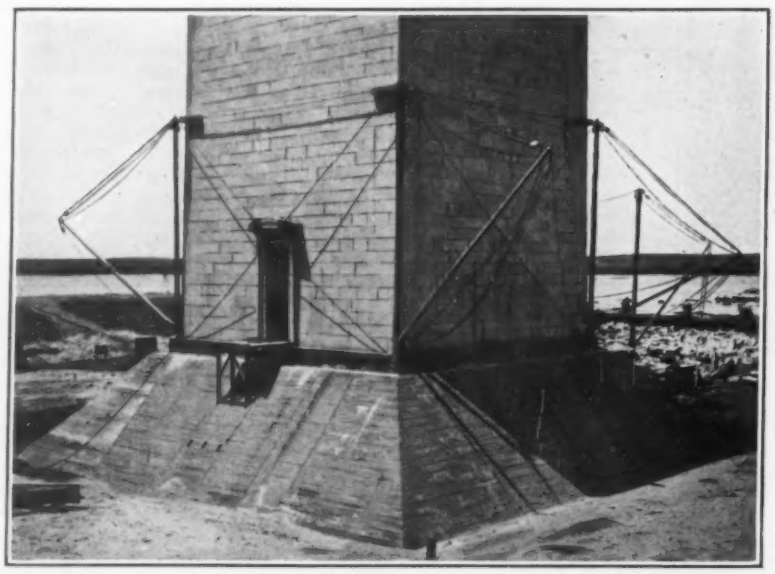
Eight years later, in 1833, some influential citizens of Washington, hopeless, apparently, of any action by Congress, formed the Washington National Monument Society, with Chief Justice John Marshall as president, and a campaign was started to secure funds. Three years later, designs for a monument to cost $1,000,000 were invited, and the competition was won by Robert Mills, whose plans called for a circular colonnaded building, 250 feet in diameter and 100 feet high with a 500-foot shaft raising from its center. The colonnade feature was never adopted.

Twelve years later, in 1848, Congress authorized the society to erect a monument to the memory of George Washington at the present site, and the corner stone was laid on July 4, 1848, at which time the society had collected $88,000 towards defraying the estimated cost of $1,000,000.



Cross-section showing the walls of shaft 15 feet thick, the original foundation, nd the new concrete buttresses resting on a hollow, rectangular slab, measuring 126 ft. 5½ inches on each side

The foundation conditions were found to be good. The underlying strata was very compact, and at the depth of 20 feet, a solid bed of gravel six feet deep was encountered. The original foundation was 80 feet square at the base, 23 feet 4 inches deep, built in pyramidal shape with the sides stepped, as shown in the illustration. It was built of blue gneiss, in blocks weighing from six to eight tons. The base of the monument proper, measured 55 feet 1½ inches square, the walls at this point being 15 feet thick. The first 150 feet of the shaft were built with dressed white Maryland marble, and this height was reached in six years' time, or by 1854, when work ceased for lack of funds.



The underlying slab and sloping buttress completed, ready for refilling the soil to the base of the shaft

Five years passed and then, in 1859, Congress passed an Act incorporating the Washington National Monument Society for the purpose of completing the erection of the monument. The Secretary of War appointed Lieutenant J. C. Ives, Corps of Topographical Engineers, to superintend construction. He examined the foundation, and reported that it was entirely satisfactory. Shortage of funds delayed the work, until Congress took action and appointed a committee to confer with the society. This was in 1873, and in 1874, on the recommendation of Lieutenant W. F. Marshall, Corps of Engineers, later Chief of Engineers, it was decided that the height of the shaft should be reduced from 600 to 500 feet, so as to avoid excessive pressure on the soil of the foundation. It was not until August 2, 1876, that the thing was done which should have been done many decades before; for in that year, President Grant approved an Act which provided that the Government should take over and complete the erection of the monument, and that the Corps of Engineers should report on the sufficiency of the foundations. This board reported that the foundation was not sufficient to carry a shaft of the proposed height, and, thereupon, was undertaken the important work of underpinning the foundation, which is shown in the accompanying illustrations. This was done under the direction of Lieut. Colonel Thomas Lincoln Casey, afterwards Chief of Engineers. The trouble with the old foundation was that it was too shallow and covered an area insufficient to sustain the pressure which would come upon it when the shaft had been carried to its full height. The strengthening consisted in enlarging the foundation by spreading it over a greater area and sinking it a greater depth into the earth.

By reference to our line drawing, showing a section through the foundation, it will be seen that, except for a central space 45 feet square below the old foundation, a massive square concrete slab, measuring 126 feet 5½ inches on each side, and 13 feet 6 inches in thickness, was built below the original foundation. Start-

(*Continued on page 72*)

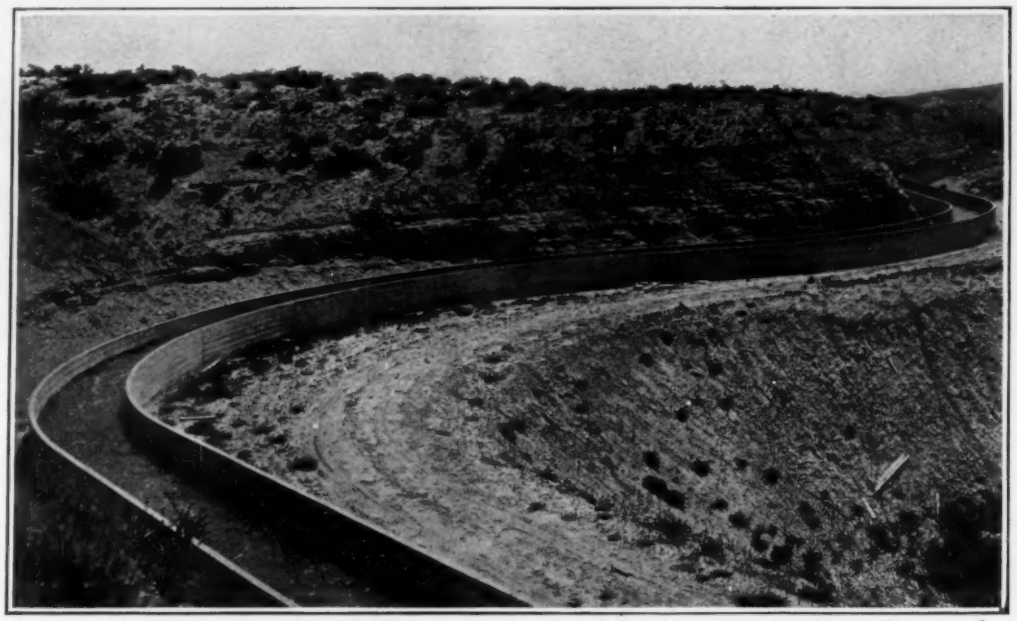
A Canal that Grows Crops in a Barren Country

ONE of the most curious canals in all creation is that now operated by Uncle Sam to carry the waters of the Malad River in southern Idaho to the King Hill irrigation project in the Snake River Valley. Without water for irrigation, 17,000 acres of land in that neighborhood would be practically worthless. However, with plenty of moisture available, the locality will produce luxuriant and profitable yields of every crop that can be raised in the Temperate Zone. Alfalfa, early vegetables, grain, fruit and stock are the leading money crops. Due to favorable climatic conditions, the King Hill farmers can market early vegetables from two to three weeks ahead of any of their rivals.

The water of the Malad River is diverted into the canal at a point one mile above its mouth. The water is carried 4000 feet through a large flume in the Canyon of the Malad. The main canal is 52 miles long, five feet deep and 8½ feet wide. It has four large bridges and siphons across the Snake River. Sixteen miles of the canal features concrete-lined banks, it being one of the most extensive of the western irrigation channels of a permanent nature. The Malad River is fed by springs so that it is a dependable source of water. The yield of water throughout the irrigation season which lasts 193 days is adequate. Plans are now under way to construct emergency water storages as sources of emergency moisture during abnormal seasons.

The irrigation of the Snake River Valley has not only provided homes for a great number of citizens who, otherwise, would have been unable to obtain farm homes, but it has also created taxable values in excess of the entire cost of the project. These values are of a permanent character and will endure and be a perpetual benefit to the community, State and Government. The course of the canal is very crooked and tortuous, as is shown by the fact that the waterway extends over a route of 52 miles in providing artificial rainfall to but 17,000 acres of farming land. More than five miles of wooden flumes have been replaced recently by concrete flumes and siphons. These improvements are practically everlasting, while wooden construction rots out in about ten years.

The King Hill Canal is interesting, inasmuch as after the private company that originally owned it failed, Uncle Sam took control of the water plant, spent over a million dollars in improving it and now has developed it into one of the best small water projects in the Western States. He has built and is testing out the efficiency of five different types of flume construction. They consist of wood, monolithic, gunite, gunite and concrete and concrete semi-precast construction. Thus far the last three types have been most satisfactory. Where the topography is very steep and conditions do not permit of doing the concrete work directly at the scene of flume construction, the semi-precast system of building the flumes has proved practical. The concrete slabs are made in sections 12 feet long which weigh 3660 pounds apiece and then are joined together with sections of burlap soaked in tar. Altogether more than 17 siphons have had to be built which range in diameter from 48 to 100 inches. The gunite method of construction which features the use of cement guns for the deposition of the concrete aggregate has proved particularly satisfactory under circumstances where any leakage of water which occurred might damage the foundation of the flume. The gunite flume is very durable and wearworthy despite that its walls are but 2¼ inches thick. It can be built quickly and efficiently at lower outlay and with less labor than any other type. It promises to play a prominent part in revolutionizing flume construction.



A piece of the 52-mile canal that carries the mountain waters of the spring-fed Malad River to the irrigated farms of the Snake River valley

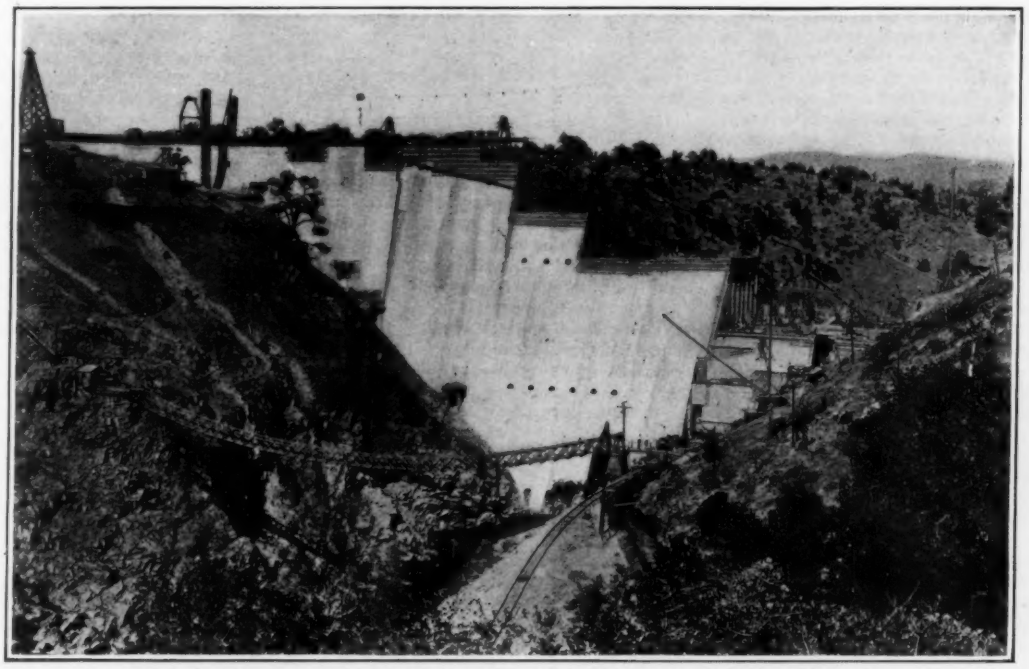
Harnessing the California River

ONE of the latest of the California irrigation works is represented by the Don Pedro dam which was completed early this spring. The dam, which is situated ten miles above La Grange on the Tuolumme River, is believed to be the second highest irrigation and power dam in existence, overtopping the famous Roosevelt dam at Phoenix, Arizona, by several feet. It is 283 feet high, 177 feet thick at the base, 16 feet wide at the top, and 1000 feet in length. It will serve to create a reservoir covering 3276 acres, and will store 289,000 acre-feet of water, and serve to irrigate 165,652 acres of what will prove to be highly productive land. Also, its waters will serve to develop 17,000 horsepower, which will be distributed among the owners of the irrigated land for application to lighting and power.

As will be seen from our illustration, the dam is being built in a series of great steps, and an interesting feature of the work is the method in which gravity is used in placing the concrete. At or slightly above the level of the crest of the dam are large mixers which turn some 2000 tons of gravel, sand and cement into 1300 yards of concrete on every working day. From the mixers miniature trains, driven by gasoline motors, carry the liquid concrete out upon the completed portion of the crest of the dam, from whence it is conveyed in a series of flexible pipes down to the newly erected forms at the various levels of the finished work. A power house, which is built a hundred feet up the canyon against the dam, contains three turbine generators, each capable of producing 6000 horsepower.

Within the body of the dam itself are 4300 feet of auxiliaries leading to valves which regulate the flow of irrigation water. These auxiliaries extend in four horizontal planes.

The lake above the dam will cover one of the historic spots of California's gold-mine days. Don Pedro Bar, a mining town from which thirteen million dollars worth of raw gold was shipped through the Wells-Fargo express office, alone, cast fifteen hundred votes in 1860, when Lincoln was elected President. The town was destroyed by fire in 1864, and as the gold had been taken out by that time, it was never rebuilt; ultimately its site will be buried under 165 feet of water.



General view of the Don Pedro dam in California, said to be the second highest irrigation and power dam in the world

Quantum Mechanism in the Atom

AT a meeting of the Royal Society of Edinburgh on May 8 Professor E. T. Whittaker read a paper on the quantum mechanism in the atom.

Professor Whittaker shows that it is possible to explain upon the completed portion satisfactorily in terms of the classical electrodynamics without postulating any structure in the atom beyond that by which it is customary to explain induced magnetization. The author considers the effect of an approaching electron in producing a "magnetic current" in the atom; up to a certain velocity of approach the electron does not get beyond the atom but suffers an "elastic impact" which repels it without loss of energy. When, however, the velocity of approach exceeds this critical value the electron passes through the magnetic atom and gives to it energy of exactly that amount or quantum which corresponds with the critical velocity. The transformation of this energy into radiant energy can be explained by generalizing the conception; thus the magnetic current becomes equivalent to a charged condenser, partaking of the nature of a Hertzian oscillator. By a simple mathematical process, combined with the assumption that the oscillators in the atoms are similar to each other in structure and differ only in scale, the equation $h\nu = U$ can be established, giving Planck's relation connecting the frequency, ν, of the emitted radiation with the amount of kinetic energy, U, absorbed from the bombarding electron. Photo-electric phenomena can be interpreted on the basis of this theory, and Bohr's theory of series-spectra likewise finds an explanation.—Abstract from *Nature* for July 1, 1922.

1: In laying the tile it is extremely necessary that no pockets or local reversals of slope be introduced. As tile of small diameter are sometimes laid on gradients of as low as one inch in one hundred feet, although this is unusual except in the case of large tile, the accuracy of the gradient is more easily maintained by raising all the interval points an equal distance to levelled cross-bars. The proper gradient is then given the cross-bars and the tile must be placed at uniform distances below it. This elevates the work from the dark, muddy ditch to a more workable level. 2: Back-filling with an ordinary plow and two horses drawing from the opposite ends of a long evener. 3: An endless chain type of trenching machine, with the chain and buckets elevated from the ditch. 4: Laying large-sized tile with the aid of an easily moved tripod that straddles the ditch

Equipment used in trenching and laying tile

Draining Land With Gasoline

How the Scarcity of Labor has Brought About the Use of Machinery for Marshland Ditching

By S. R. Winters

TAKING no account of vast areas of overflow and swamp lands subject to the reclamation facilities of private and governmental agencies, there are 43,873,000 acres of farming lands in twenty-eight American States whose crop-producing powers could be enhanced by drainage. According to sectional distribution, tile could be buried advantageously along an expanse of territory embracing 22,556,000 acres in ten Southern States, there being 6,000,000 acres of wet lands in Louisiana alone. In nine Western and Middle Western States underdrainage would quicken and increase crop yields on 12,300,000 acres, while in an equal number of Northern States trenching machinery would redound to the benefits of 8,417,000 acres.

This official computation, data hitherto unpublished, is based on an investigation made by the Drainage Division, Bureau of Public Roads, which serves to heighten interest in behalf of adequate drainage as well as to emphasize the achievements already credited to modern machinery and methods in removing excess water from agricultural areas. Over against the background of the compilation relating to the vast regions in need of tile underdrainage is the encouraging accomplishment of ditching mechanism in four Middle West States—Ohio, Indiana, Illinois and Iowa—where the work has been so all-embracing as to render difficult any reliable calculation as to the untouched farming acres. Progress in this group of States is unmistakable, and where accumulated moisture has not been displaced the agencies of organized effort are well on toward the execution of systematically defined plans. One county in one of these above-mentioned States supports 200 drainage districts, while still another county has in operation 50 expensive tile-trenching machines.

Marked innovations — although seemingly slow of evolution — have been inaugurated since the auspicious day in 1835 when John Johnston laid the first drain tile in the United States, the event taking place in Ontario County, New York. Significant it is that 84 years later —in the spring of 1919—not far removed from the spot where the historical tile-laying was commemorated, farmers pooled their interests, organized a company, and cooperatively acquired a power-trenching machine. The methods employed by Mr. Johnston are mainly in vogue in this particular locality. Elsewhere a larger diameter of tile has been installed, the two-inch measurement having been abandoned for four-inch material; while in the efficiently organized drainage districts of the Middle West, tile of five inch diameter is favored. The reason for the larger tile is obvious, inasmuch as any irregularity in the make-up of small sized drain for conveying off the accumulated water is decreased in proportion. The variously shaped tiles of former days—distinctive among the types being the horseshoe tile with a flat bottom, either open or closed—have been superseded by those of a cylindrical shape, that is, with a round bore. In recent years, concrete tile has come into extensive use, its adaptation having been very widespread in the Middle West. However, the popularity of clay tile is not to be minimized.

The veteran ditcher—whose predilection for the use of the simple spade had its source in other lands than America—is fast disappearing, according to the drainage engineers of the Bureau of Public Roads. Attractive wages in the city, shortage of labor in more profitable occupations, and economic disturbances are probably the causes which have speeded the going of the immigrant who obtained his knowledge of the rudiments of ditching "in the old country." His departure has been capitalized, mechanical ingenuity has worked at top speed, and the development of a multitude of tile trenching machines, operated by steam or gasoline engines has been the fortunate result. Instead of the laborious hand method of installing a system for facilitating the flow of excess water, machinery digs the trench to the specified depth at a single operation. The types of implements vary from the inexpensive ditching plow, costing from $20 to $500, to the costly equipment designed for contractors and large plantation owners, entailing an investment of $5000.

A horse-drawn ditcher for shallow tile ditches

D. L. Yarnell, senior drainage engineer of the Division of Drainage Investigations, summarizes the three requirements of a good trenching machine. It should operate efficiently in all types of soils, should be capable of cutting true to grade, and should have the capacity for standing up under working periods of indefinite length without disarrangement or breakage. Hard shale, cemented gravel, sand, stones, loose loam, soft muck, and sticky clay, comprise the varied assortment of soils, for having a versatile equipment, it can be adapted to varying conditions. For instance, open or skeleton excavating buckets are best suited to sticky soils; while solid buckets perform efficiently in loose, dry soils. Obviously strength is a prerequisite for a machine that would labor in shale or stony ground—lest the barrenness of its results should be like the scriptural sowers of seed, its efforts being non-productive.

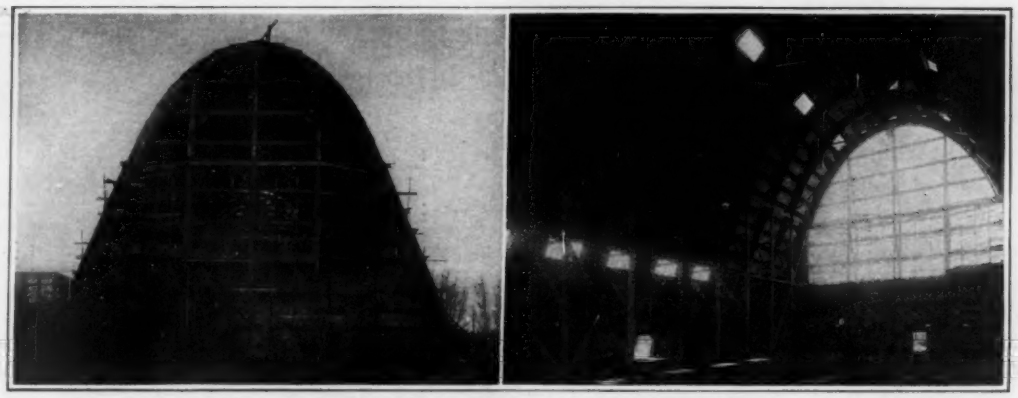
According to classes, trenching outfits are four in kind: plows, scoops, wheel excavators and endless chain excavators. The names of the first two betray their natures. They are operated by horses, and they frequently function simply to loosen the dirt in order to facilitate hand shoveling. "Wheel excavators" is a term which has reference to the fact that the buckets are arranged around the outside of a wheel, while the buckets on the endless chain type are conveyed on parallel endless chains supported by a long steel frame at the rear of the machine. One end of the frame is lowered so that the buckets are drawn upward toward the machine and thereby cutting a thin slice of earth from the bottom to the top of the trench. Scraper excavators are identical with the drag-line machines designed for wide ditches, being sometimes slightly changed in rigging, thereby insuring a wieldly control of the bucket.

The ditching plow is economical on small jobs where more expensive equipment could not be afforded. A limited amount of handwork is required to smooth the trench for laying the tile. The capacity of the ditching plow is frequently limited to the excavation of a trench of only 2½ to 3 feet in depth, a depth not adequate in numerous localities. It is primarily a farm tool, serving the purposes of the farmer who desires to drain a portion of his land. The implement is powerless in extremely wet and boggy soils where horses cannot travel. The outstanding virtue of this type of equipment in contrast with those of the elaborate excavator is its cheapness.

(*Continued on page 72*)

Concrete in Surprising Places

BY employing the principle of the arch, large surfaces may be roofed over in a very simple manner by the use of reinforced concrete, and this method is especially applicable where it is required to construct aero-sheds having a considerable size. For airship use, the question of the height of the structure is another factor which enters into the consideration. A good example of recent practice is shown in the large aero-shed which was built for the French Navy at Montebourg by the Fourré-Rhodes establishments, according to the plans of Engineer Lossier. The outside dimensions of the structure are, length 500 feet, width 133 feet, and height 100 feet.

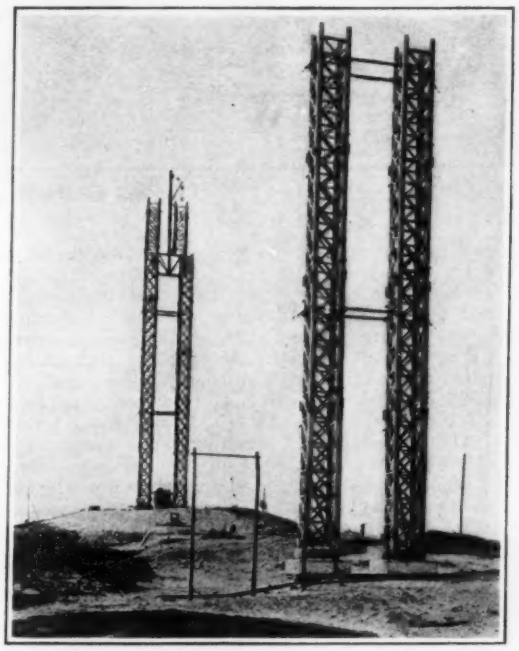


Outer and inner views of the end of an aero-shed of reinforced concrete, a recent French design

In principle, the portion which forms the vault is kept separate from the side or upright part of the structure, but to the eye, the whole has the appearance of a uniform construction, and as will be observed in our engraving, the principal members are spaced along the length of the shed and have a general parabolic shape. But for each of these principal members, the lower part consists in reality of a girder of triangular shape, having on the inside a straight or vertical beam and on the outside an inclined beam, these being considerably spaced apart at the bottom to form the base of the structure, while they are brought together at the top, the whole being suitably cross-braced. On the top of this substantial girder which may be likened to a half-tower, is mounted the reinforced concrete beam which is curved into the general shape of the vault, and it rests on the base portion through the medium of a special joint of the kind which is now commonly employed for this class of structural work and termed semi-articulation, and in which the metal rods form practically the entire connection between the parts. The main girders of the structure being thus obtained, they are cross-connected by the longitudinal portions which run along the whole length of the shed, then a special slab of reinforced concrete of light and strong make-up is laid over the spaces in order to cover the building.

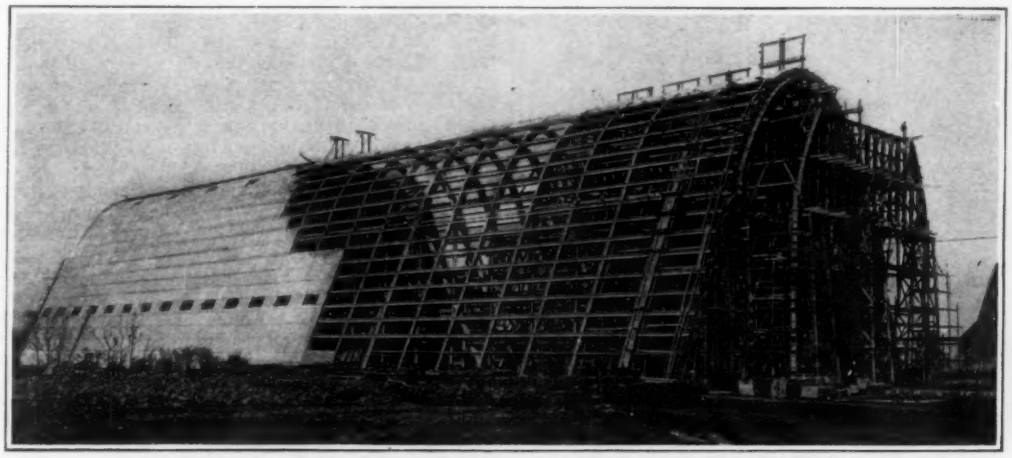
The triangular upright members are spaced in pairs at 80 feet representing the inside width of the shed, and have a spread of 26 feet 3 inches at the base. Both the straight and the inclined beams contain six reinforcing bars of round iron. At the bottom of each is a good sized base of three feet three inches square, the reinforcing bars passing down through the base and anchoring in a concrete foundation of five feet square. The uprights are molded and flowed with concrete on the spot, being spaced along at 10 feet 6 inches between centers, but the horizontal connecting beams are made up at the works, leaving the bars projecting out at the ends of these pieces so as to be able to make connection with the vertical members while these latter are being formed. The cross members have a general square shape, but are given a channel bar section for the sake of lightness, the fleet side being turned outwards, this portion having a small rib along the top and bottom. Spaced apart at six feet four inches on the height of the shed, these beams serve also to support the flat covering slabs. The top or arched portion of the shed consists of beams formed in parabolic shape and corresponding to the base members upon which they rest by the semi-articulations, another joint of the same character being provided at the top of the vault.

One of the original features of the new construction is the use of a large flat covering slab which was designed by M. Minard, and it is of unusual size, measuring some 7 feet by 5 feet 6 inches. These reinforced concrete slabs which are simply laid upon the structural beams after the manner of the customary roofing tile, are very well adapted wherever a large surface requires to be covered, and may thus find numerous applications. There need no longer be any apprehensions as to an excessive weight of material when it comes to applying reinforced concrete for the sides and especially for the roofing of structures, and especially in the case of large sheds for airplanes or airships. A very light weight is obtained for the present type of roofing slab. In spite of its large size, it can be made as thin as 0.4 inch, and the metal reinforcing portion consists of wire gauze with very small mesh. As noticed in the sectional view, it is formed with a stiffening or ribbed portion along the sides and has two additional ribs of suitable shape at the middle part. The top and bottom parts are given a suitable shape for applying the slab upon two of the cross beams of the structure, this method being very simple and convenient. In order to facilitate the handling of the slab, which weighs about 330 pounds, the lower iron rod which is used for reinforcing the middle ribs is made to project somewhat at the top of the slab and has the shape of an eyelet, and this also aids in securing the slab to the cross beam. Tests for the strength of these reinforced concrete slabs are made by supporting them at the ends and loading them over the whole surface with sand, representing the weight which the slab is required to support.



Another surprising application of reinforced concrete—in high radio towers

These interesting sheds do not by any means exhaust the novel uses of reinforced concrete, which are in fact being added to almost every day. Just as a further example may be mentioned another French development which involves the use of this type of structure for towers of extreme height. Radio towers especially are being built in this way, and are attractive in appearance as well as substantial. Tempests will not blow them down, as was proved by some of the high towers erected at St. Pierre. What is a novel feature is that the tower can be made up, say, of 15-foot lengths, which are formed on the ground and then hoisted into place. This means much quicker work than when a steel tower has to be built.



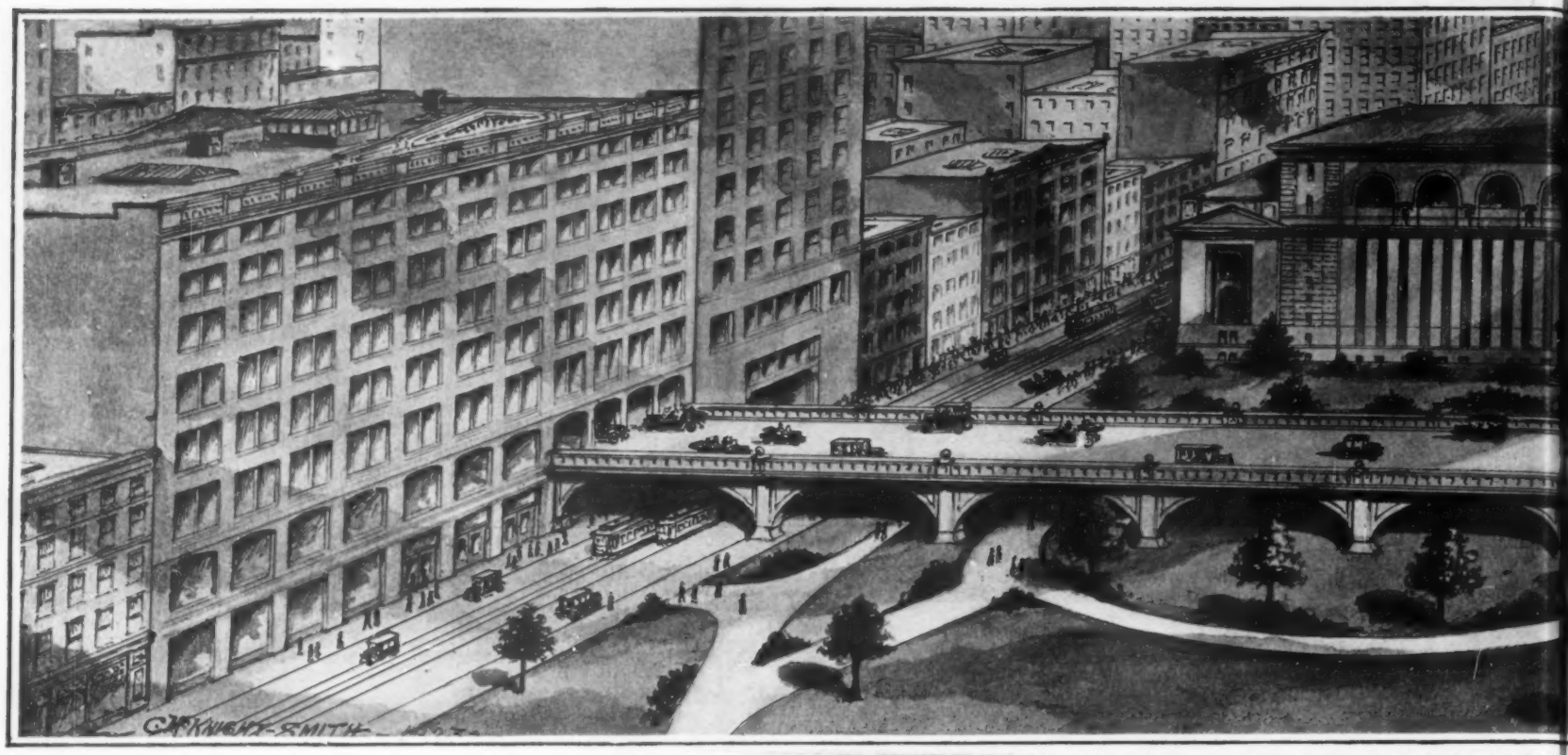
The concrete aero-shed from the side, during the process of construction

Poisoning by Illuminating Gas

THE only constituent of illuminating gas which has serious poisonous properties is carbon monoxide. Carbon monoxide has the property of forming a dissociable compound with the haemoglobin of the blood just as has oxygen, but the affinity of carbon monoxide for haemoglobin is about 240 times that of oxygen for haemoglobin. The greater the extent to which the haemoglobin becomes combined with carbon monoxide the less is its capacity to act as a carrier of oxygen between the lungs and the tissues of the body, and if a sufficient amount of the haemoglobin in the blood becomes combined with carbon monoxide the normal oxygen supply to the tissues must evidently be seriously affected. The effects produced by severe carbon monoxide poisoning are, in fact, those of slow or rapid asphyxiation.

The minimum concentration of carbon monoxide that will prove fatal is not known with certainty, but the available evidence points to the conclusion that death will ensue after an exposure for several hours to air containing 0.2 per cent of the gas. Much depends on the length of time that the blood has been highly saturated with carbon monoxide, for the longer an extensive shortage of oxygen is maintained, the more serious is the damage to the tissues of the body, particularly to the nervous system, and the more difficult is recovery. Bearing this in mind, it is not improbable that 0.15 per cent of carbon monoxide in the air breathed might prove dangerous to life in the case of prolonged exposures, according to *Nature*.

Exposure to relatively high concentrations of the gas leads, of course, to rapid loss of consciousness and death, but in accidental cases of poisoning the concentration of carbon monoxide is, as a rule, comparatively low, and in these circumstances the onset of symptoms will be gradual though progressive, for the gas, owing to its low concentration, will diffuse but slowly into the blood and it will be long before complete gaseous equilibrium can be established between the blood and the air in the lungs. Herein lies a great danger, for so insidious is the onset of the symptoms that the person affected may not realize that anything is amiss until he has lost so much of the power of his limbs as to render it impossible to withdraw from the danger. With 0.1 per cent of carbon monoxide in the air breathed a resting person will become disabled in about two hours and a half, with 0.2 per cent in little more than an hour, and with 0.4 per cent in about half an hour.



Proposed automobile elevated roadway, to extend north and south through Manh. The

Solving the St Tra

Speeding Up Traffic by Separat Thre

IT IS doubtful if many people outside of a few who have made a special study of the congestion of street traffic are conscious that, because of the multiplication of automobiles and motor trucks, some of the larger cities of this country are threatened with an absolute tie-up of traffic in certain congested centers which cannot be long delayed.

There are today between ten and eleven million registered automobiles in the United States, and the curve of increase is rising at an accelerating rate. Already the main thoroughfares of the more densely settled sections of the country are showing signs of congestion, and on holidays and Sundays the situation has become unbearable. It is in the larger cities, however, that the crowding of the streets has reached a point where it has become a daily and very serious problem, with promise, if emergency measures are not at once undertaken, of producing on the main thoroughfares, and particularly at certain intersections of the main streets, an absolute deadlock during the busier hours of the day.

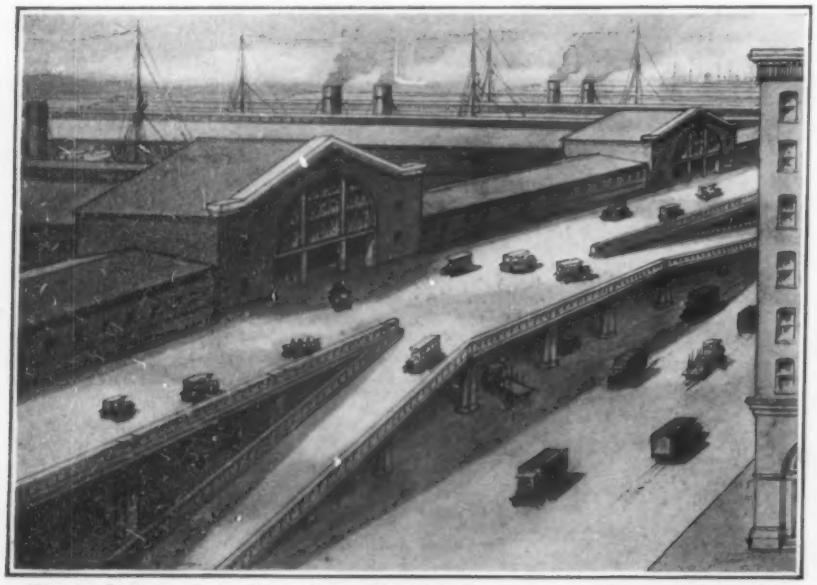
The most serious conditions are to be found in the largest cities, where we should naturally look for them, and particularly in New York, where the traffic doubles every three years. Here, the congestion which naturally arises from a great congregation of inhabitants is intensified by the fact that Manhattan, which constitutes the business center of New York, is a long and comparatively narrow island, in which the principal flow of traffic is north and south along the length of the island, with the short east-and-west streets serving merely as feeders to the congested north-and-south thoroughfares.

The north-and-south street travel is accommodated on eleven avenues; and if the automobiles and motor trucks were distributed evenly among these, all would be well—but it is not. On the contrary, the traffic on the avenues near the Hudson and East Rivers, except on West and South Streets, is comparatively light; it grows denser as the center of the island is approached; and it is found at its worst on Fifth Avenue, where the conditions are unspeakably bad and rapidly growing worse.

Other things being equal, the amount of traffic we can pass through a given thoroughfare in a given time may be said to be proportional to the average speed of the vehicles. In New York there are several conditions which slow down this speed. Chief among these are: First, the fact that fast and slow moving vehicles are using the same thoroughfares; second, that many of the streets are occupied by surface cars which, when they stop, as they do at practically every street corner, cause the automobile traffic behind them to stop until the alighting passengers have left the car and new passengers are taken on; third, the fact that on several thoroughfares the free flow of the traffic is hindered by the columns that carry the elevated railways; and lastly, there is the unfortunate fact (for the flow of traffic) that the city fathers laid out the blocks, so that their longer sides run east and west and their shorter sides north and south, with the result that the crossings come three times as frequently on the avenues as they do on the cross streets. Now, of these unfavorable conditions, the last-named can never be changed; but the other three—namely, the presence of fast and slow traffic on the same avenues, the presence of street-car lines on the d create nues, and the presence of the elevated structures, are roadwa essential, and the solution of this stupendous problem. Such be obtained only when the city takes the drastic mea officials, of removing some or all of these three primary obst carry int

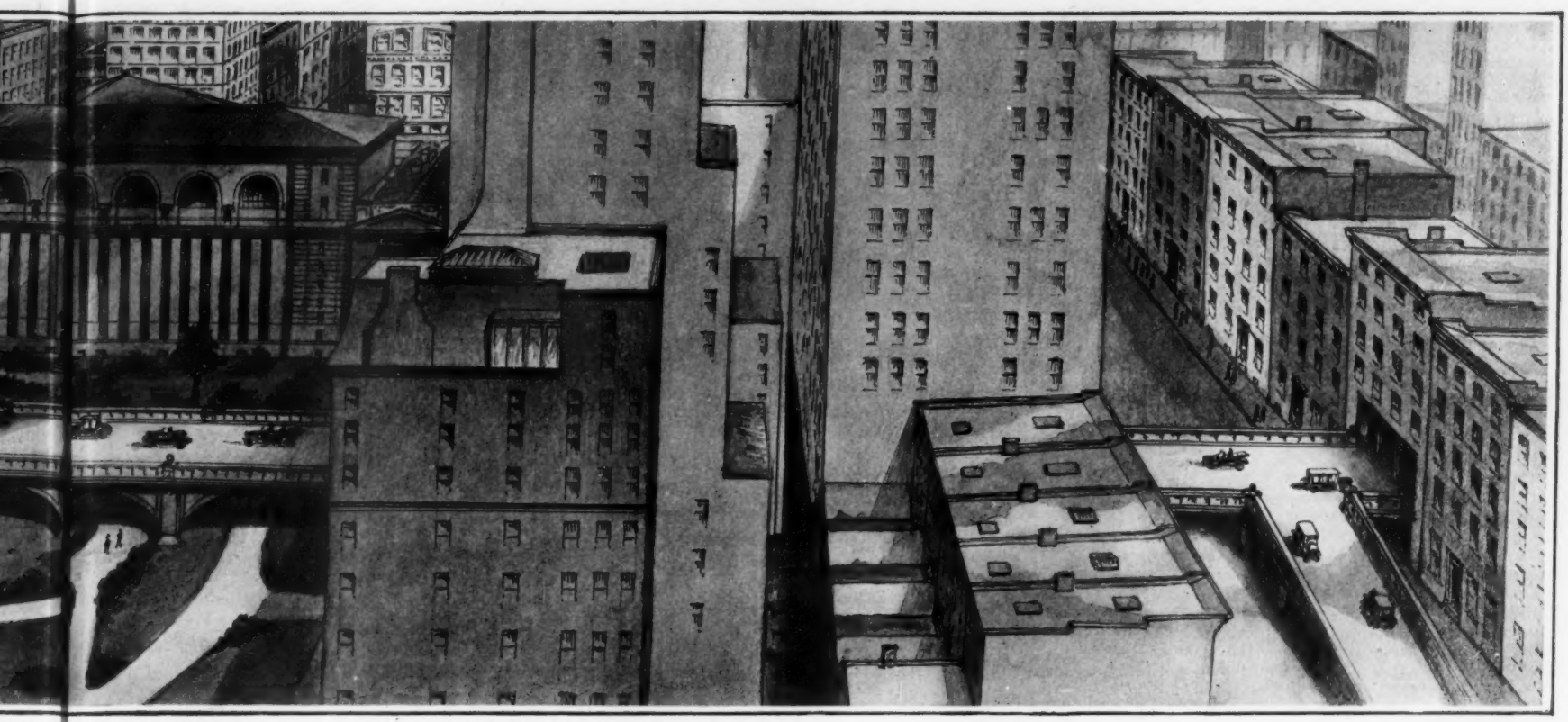
In the City of New York the Police Department scribed closer touch with the traffic problem than is any o importa branch of the city government. The Traffic Squad ted aut been making heroic efforts for years past to cope with the increasing congestion; and from time to time it has formulated rules based upon past experience, which have made it possible to keep the full flood of traffic moving—in a fashion. Today, however, Richard E. Enright, Police Commissioner, has come out with the statement that, frankly, he has done all that he can in the way of traffic adjustment, and that the situation calls for immediate and very drastic remedy. He assures us that a definite traffic plan, approved by the city and the public, must be got under way at once. This plan must utilize to the utmost our present facilities, and it must be one that can be put into operation without unnecessary delay.

The Commissioner believes that we



Proposed elevated roadway down West Street for fast, through automobile traffic, from Riverside Drive to the Battery

Lower Manhattan, showing es the W roadway and the extensi Avenue



gh Mans. The structure would pass through the center of the blocks

St Traffic Problem

para Through and the Local Traffic

s on the d create a permanent board, with authority to project ures, ar roadways for the handling of present and future problems. Such a board is essential, since it is difficult for stic me officials, who are continually changing, to prepare ry obst carry into effect a comprehensive plan like that which rtment scribed and illustrated in the present article. The s any important suggestion is for the construction of an Squa ted automobile roadway, carried north and south through the center of the blocks between Fifth and Sixth Avenues. For the present, it would be sufficient to build this roadway from 59th Street to Washington Park. Ultimately, it would be extended as the situation might require. Where the cross streets are intersected the roadway would form an elevated structure, having sixteen feet of headway, and designed on artistic lines so as to soften the usually harsh appearance of such structures in this city. The roadway would take up the space between the second and third floors of the buildings through which it ran. The shops opening on the cross streets, and the offices and establishments above the third floor would not be disturbed. Now this idea is not so radical as it might seem at the first blush, for the four walls of the structure would be of concrete, and since only pneumatic-tired traffic would be permitted, there would be no noise, odor, or vibration to disturb the occupants of the building.

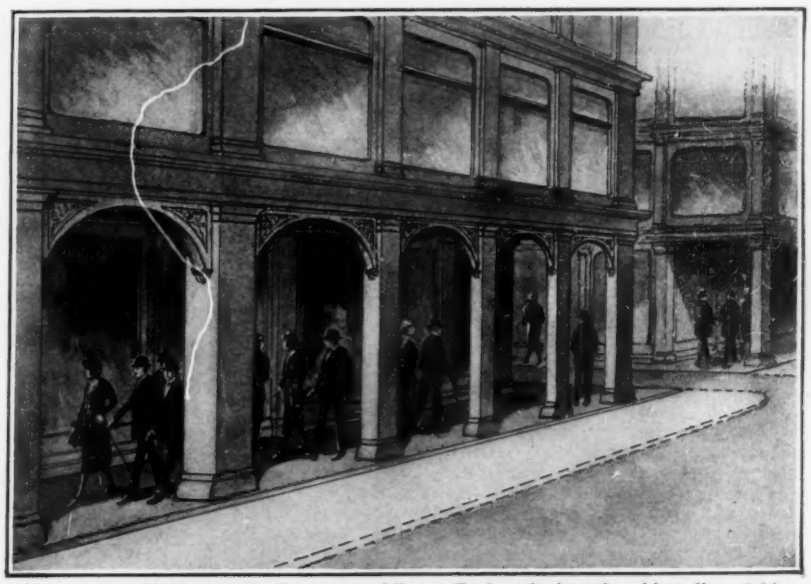
owing es the West Street elevated xtensi Avenue to South Street

Another addition to the traffic capacity in a north-and-south direction would be secured by the removal of the elevated structure from Second Avenue, between the Harlem River and Chrystie Street, and the enlargement of Chrystie Street to the same width as Second Avenue. At the Plaza the route would swing under the bridge approach to continue at full width on Market Street to South Street, on the East River. Thence it would follow South Street down to the Battery.

Another important increase of travel facilities contemplated in this plan is the construction of an elevated roadway, wide enough for several lines of traffic, from the neighborhood of Riverside Drive, down the westerly side of West Street, to the Battery. Both this structure and the one built through the center of the blocks between Fifth and Sixth Avenues would be provided, at suitable intervals, with ramps leading down into the side streets, by which local traffic, or fast through traffic, for that matter, could enter or leave the elevated roadways at any point desired throughout the full length of the city.

Another important suggestion of the Commissioner is to give up the whole width of Fifth Avenue, from building-line to building-line, to street traffic, moving the sidewalks within the building line, and thus forming a continuous arcade for the whole length of Fifth Avenue between 59th Street and Washington Square, or as far south as the present conditions and future probabilities of congestion render advisable. The removal of the sidewalks would provide accommodation for at least two more lines of traffic in each direction.

The Commissioner's plan will be criticized on the ground that these are very sweeping and costly measures. They are; and the situation is such that they have to be. Matters cannot go on as they are. The urgency is so great as to call for the immediate formation of a thoroughly expert commission, carefully chosen from men who are qualified for the study and solution of traffic problems. The commission should be independent of party politics and it should be a permanent body. We owe our fine water supply to the formation of such a board in Mayor McClellan's day; and this great public work is a lasting tribute to his wisdom and far-sightedness. The traffic problem rivals the water supply problem in importance. If the present Mayor would listen to his Police Commissioner and create an expert, non-political Board on Traffic, he would confer a lasting benefit upon the city.



Widening of Fifth Avenue for automobile traffic by placing the sidewalks within arcades, thus providing for four additional lines of automobiles

Ruling of Scales by Means of Light Waves

THE Bureau of Standards has recently completed the ruling of 10 six-inch scales for a manufacturer of precision tools using the method recently developed which depends on the interference of light waves. The first inch of these scales is ruled in fortieths, and it is interesting to note that these scales are of such a degree of accuracy that when used for the work for which they were designed, no corrections whatever need be introduced; in other words, they are perfect instruments for their purpose. Two similar scales were ruled for the use of the Bureau, and another of extreme accuracy, 1 mm. in length with lines 10 microns apart, was ruled for the use of the length section.

Digging in Sacred Soil

Research With the Spade in Palestine Since the War

The well of Harod, where Gideon selected his braves

GREAT Britain has risen to the full measure of her responsibilities in Palestine, both as regards the protection of the historical monuments and sites and the organization and encouragement of research in the Holy Land. A British School of Archæology (analogous to the older-established institutions at Athens and at Rome) was founded in Jerusalem soon after the end of the war, to provide a home and center for research and advanced study. Sir Herbert Samuel, his Majesty's first High Commissioner for Palestine, created, as one of his first official acts, a Department of Antiquities for Palestine, charged with the protection of the historic monuments of the country, the arrangement of a national museum, and the organization and control of excavations and research. The Government properly regards the administration of the antiquities of Palestine as a trust confided to it by the whole world; accordingly, an International Board, of which the Director of Antiquities is Chairman, advises the Department on all matters of public interest. This board includes representatives of the different communities, and of the societies of foreign countries engaged in archæological research in Palestine.

The first fruits of this new endeavor are now becoming visible. Professor John Garstang, D.Sc., of Liverpool University, gives through *The Illustrated London News*, an account of the progress of historical research, and the protection given to ancient remains in the Holy Land, under the established British regime. Professor Garstang is the organizing director both of the British School of Archæology in Jerusalem and of the Department of Antiquities for Palestine; he writes with the authority of scientific experience and those who may have entertained doubts as to how far political and other considerations might affect Great Britain's fulfilment of her trust in regard to the antiquities of the Holy Land, will be reassured and gratified by the professor's definite accounts.

Special monuments, like the great Crusaders' Fortresses of Acre and Athlit, the Roman city of Cæsarea, and the Philistine site of Askalon, have been put under guardians, and museums are being organized, where all the local remains may be preserved and studied. A central museum has been established in Jerusalem, with a distinguished Oxford graduate as keeper, and already the framework of a representative collection is open to the public.

It is in the field of excavation and research that the most noteworthy activity may be recorded. The new regulations may appear to be severe and meticulous, but in practice they are found to be a real safeguard against unscientific treasure-hunting, and while protecting the just rights of the national museum, they provide efficient help and encouragement to properly conducted expeditions working on behalf of societies whose academic and scientific status is unquestioned.

Our map shows the sites already being excavated, and those where work is projected for the next season. No fewer than eight properly equipped expeditions are at work and the results of this combined effort promise to be far-reaching. On the eastern side, in the Jordan Valley, at Ain Duq, near Jericho, the French Archæological School (Ecole Biblique) conducted by the Dominican Fathers has cleared and removed for protection portions of a mosaic pavement of an ancient synagogue of the third century. Hereabouts is the famous mound which marks the site of ancient Jericho. Considerable clearances were made here in the course of excavations made in other days, disclosing walls of undoubted antiquity, both those of houses and main walls of the city. But the historical interpretation of these researches is not complete. The excavation was not made with that due regard to minutiæ which modern science demands; and there lacked then, as now, sufficient comparative material, properly collated and arranged, by which to deduce the full and logical results from the work done. Doubtless some learned society will come forward in the future to undertake the task in a modern fashion.

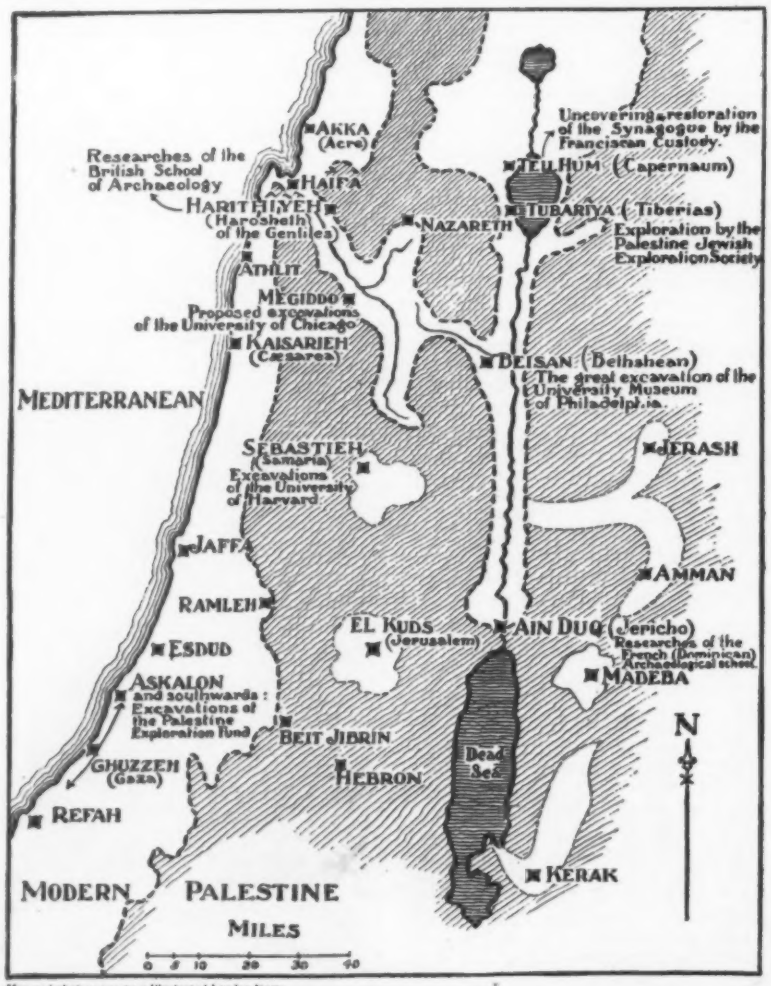
Further north is Beisan, the "Key to Palestine," dominating the junction of the valley of Jezreel with that of Jordan. Here the University Museum of Philadelphia has commenced work on a well-conceived plan under the able direction of Dr. Fisher, backed up by resources proportionate to the undertaking, and rewarded at once by historical discoveries. Further west, in the plain of Esdraelon, is Megiddo, overlooking that most historic battlefield the memory of which survives in the suggestive word Armageddon. Here the University of Chicago, at the instance of Professor Breasted, will work. At the entrance to Esdraelon, the narrow neck leading from the plain of Acre, are Harithiyeh and Tell 'Amr, commonly identified with "Harosheth of the Gentiles," which looms large in the Song of Deborah as the advanced post of the Syrian league and the House of Sisera. It is here that the British School proposes to commence investigations this year. Samaria, crowning a hill in the heart of the hill country, has already been partly excavated, and in true scientific fashion, by the University of Harvard, under the leadership of Dr. Reisner; the same body has applied for a new concession.

Part of the ancient wall of Jericho now uncovered

The views shown on the facing page are as follows:

1: The ancient town of Tiberias, on the Sea of Galilee. 2: Where Christ "entered into the synagogue and taught" in Capernaum. 3: Armageddon, the symbol of world conflict. 4: Where Samson carried away the gates and pulled down the temple of Gaza. 5: The port of Caesarea, once the Roman capital of Palestine. 6: A field of biblical disaster, where the shield of Saul rusts "unanointed with oil." The mountains of Gilboa, the Vale of Jezreel, and the Jordan valley

SOME HISTORIC SCENES IN PALESTINE THAT ARE NOW BEING LAID BARE BY PICK AND SHOVEL OF THE ARCHAEOLOGISTS



Map and photos, courtesy Illustrated London News

Sketch map of Palestine today, showing the points at which excavations are now being carried forward

The Palestine Exploration Fund has been engaged these two years on an extensive excavation at Askalon, the ancient Philistine city; and this year that pioneer body will expand the area of its work and investigations to other Philistine sites in the vicinity, even as far as Gaza and southward, in order to obtain a proper and fuller interpretation from the historian's point of view of the very important evidence already recovered.

We may conclude this catalog of the present sites of excavation by reference to two upon the shores of Lake Tiberias (the Sea of Galilee) the interest of which is more local and the work self-contained. Just south of the modern town of Tiberias the young Palestine Jewish Exploration Society has examined the ground bordering on the lake, recovering evidences of the period of the Talmud in traces of buildings, inscriptions, sarcophagi, and a profoundly interesting relic in stone reproducing crudely but in a well-defined manner the decoration of the seven-fold "candlestick," or Minora, as described in the Book of Deuteronomy.

To most visitors to Palestine the work which has been proceeding for some years near the head of the lake at Tell Hum, under the control and direction of the Latin "Custody of the Holy Land" (ancient title descended from the Crusades), is that which appeals as of special interest and charm, alike from its character and associations as from the picturesque beauty of the scene and surroundings. For this is the site which corresponds most nearly to that of Capernaum.

The recent announcement that excavations are to be made at Jerusalem in a search for David's tomb has aroused anxiety in local religious circles of Jerusalem where it was feared that the work would violate sacred sites. The British Colonial Department, however, has issued a reassuring statement that the city stood on a triangular space of ground called Mount Ophel and this site has heretofore been of no religious interest to Christians, Jews or Mohammedans.

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Sawing Stones With Man-Made Stones

How Abrasives are Employed in Cutting and Shaping Marble and Granite for Building Purposes

By J. F. Springer

EXCESSIVE hardness is so often associated with fragility that the use of the diamond in cutting marble and granite seems more or less unusual. Similarly, carborundum, alundum, aloxite, etc., appear scarcely suitable when applied to the cutting and fashioning of stone. Yet, one or more of the artificial abrasive materials have already gone into such service and are in daily commercial use. Big circular saws have inserted teeth of carborundum, saws that are used in the cutting of marble slabs and the like. Great planing machines are in use where big granite columns receive their flutes by the employment of similar means. Marble balusters are cut with accuracy and dispatch from rectangular blocks, carborundum being the active agent. Glass itself is very hard, but it yields to the modern abrasives. In fact, the cut glass industry is just about dependent upon abrasive wheels for the production of its designs.

Inserted tooth saw in action. The peripheral speed is 5000-10,000 feet per minute

Most uses of abrasives call for high speeds. The particles of hard and angular materials are not rigidly held on the periphery of the saw. The cut is secured largely by the velocity with which the particles meet the work. It is almost, but not quite, as if the bits of abrasive were little projectiles. However, a projectile depends solely upon its own momentum, whereas the abrasive particle depends partly upon the backing of the matrix in which it is set, as well as upon the momentum possessed by it. Since the weight is quite insignificant, this momentum is due largely to the velocity. Consequently, in order that a small particle, held more or less loosely, shall really have a substantial momentum, a considerable linear speed is necessary.

The standard linear speeds run, say, from 5000 to 10,000 feet per minute. This means that the particles of abrasive meet the work at velocities roughly estimated at from one to two miles per minute.

A little reflection will perhaps suffice to show that such speeds require either a high number of rotations per minute (as with small wheels), or a large diameter of wheel, or a combination of considerable rotational speed and a moderate diameter.

Perhaps the use of carborundum inserted tooth saws constitutes the most notable of recent advances. There is, first of all, a disk of steel. This may have a diameter as small as 30 inches or as large as 84 inches, or more. The linear speed at the periphery is properly 7000 feet per minute. This can be produced at the very moderate rotational speed of 318 r.p.m. if the effective diameter is seven feet. Even with an effective diameter of 2½ feet, the r.p.m. required will only be 891. However, the work in contemplation consists of the softer stones, such as marble, limestone, sandstone. I do not know that granite is commercially cut by inserted tooth saws. Whenever this becomes practicable, the linear peripheral speed will doubtless have to be increased, say, to 10,000 feet per minute. In fact, the necessity for such high speeds may be the real reason that saws for the cutting of granite seem yet in the future.

The business part of the inserted teeth is of a very plain shape, its form being rectangular. These rectangular portions project beyond the periphery, while the basal portion lies within the circular outline of the steel disk; that is, it is set in a notch made for it in the steel. The base tapers outward on both sides. The notches also widen as one passes from the rim toward the center. Notch and tooth are so related that the tooth may be set in position in the notch and then rigidly held by a wedge which tends to force the tooth radially outward. The teeth, and especially the projecting portions are flat. They come in two or three sizes. A steel disk so dimensioned that with the teeth inserted it will have a diameter of 30 inches, will have 16 large teeth or 25 small ones. A saw 48 inches in diameter when the teeth are set will accommodate 25 large teeth or 40 small ones. A large saw such as this, when running with a linear peripheral speed of 7000 feet per minute, will be rotating at about 557 r.p.m. With 25 large teeth round its circumference, 13,925 teeth will pass a given point per minute. With the 40 small teeth, we should have, under the same conditions, 22,280 teeth passing per minute. In this latter case, 371 teeth will fly by during each second.

If we know the speed with which the work advances, we may readily calculate the number of teeth which operate on the stone per linear inch of advance. Such saws as I have been describing are adapted to cut work from 4 to 36 inches thick. Suppose the work is eight inches thick and that the saw eats ahead at the rate of 12 inches per minute. This would be one inch in five seconds. With 371 teeth passing per second, the one inch cut would be made by the action of 1855 teeth. That is, 1855 separate cuts would be made in making an advance one inch long and eight inches high. Each square inch of this advance would be accomplished by 232 cuts. This means that the work accomplished by the passage of one tooth amounts to the removal of a cross-sectional bit of stone about one-fifteenth inch high and about one-fifteenth inch long.

It has already been said that the several teeth are held in position by wedges. The top and bottom edges of a tooth are not parallel. The forward end of the tooth is, in fact, not so deep (from top to bottom) as the rear end, the words "forward" and "rear" having reference to the direction of movement of the saw. The bottom of the slot is just about parallel with the top. Accordingly, the wedge is driven from front to rear. It is said that this method of securing the teeth is adequate to all conditions. No plastering is said to be required even when cutting fine moldings, fluted columns, etc. The teeth may be removed and re-inserted at will. The saws require but little mechanism for their successful operation. Machines built for using an abrasive wheel consisting of a steel central disk and an outer rim of an abrasive set in a suitable matrix are suitable for saws having inserted teeth of carborundum. Similarly, machines adapted to rotate diamond circular saws may be used for the new type of saw. Naturally, if the saw is simply rotated and is to be given no other motion, the bed upon which the work is secured must be given a movement toward the saw. Probably the inserted tooth saw can also be mounted in a swinging frame or in a frame designed to be reciprocated horizontally.

Giving flat work a preliminary honing. Pressure on the work is controlled by means of a lever shaped like a loop

Balusters of marble and limestone are now being made in considerable quantities by means of carborundum wheels. In this process there are two methods of procedure. In the one, a machine analogous to the ordinary turning lathe is employed. The rectangular block of stone is properly set between centers on this lathe and then rotated at about 100 r.p.m. A big molding wheel of carborundum corresponds, in this case, to the cutting tool of the ordinary lathe. This has a surface the exact reverse of that of the baluster. That is, if, when the job is done and while molding wheel and finished baluster are yet in contact, a plane be passed through both axes, the region of contact will be one and the same line. Where the baluster bulges out, the molding wheel is cut in; and where the baluster is cut in, the molding wheel bulges out. This molding wheel may consist of a single piece, or it may be made up of a gang of separate wheels. It is operated at a high speed. Naturally, however, the linear peripheral speeds will vary with the varying diameters. One may say that the molding wheel should be operated at such a rate as to give a linear peripheral speed of 5000 feet per minute; but this would be a loose and vague way of speaking. It would be perfectly definite, however, to say that the part where the diameter is at a minimum should have this linear peripheral velocity; or that the place of average diameter should have it.

At any rate, the molding wheel is rotated at a sufficiently high rate and while thus in rapid action is slowly moved against the slowly rotating block. The machine is so designed as to provide a means of feeding the molding wheel into the block and thus forming the desired baluster. This machine differs from the ordinary turning lathe in that the cutting tool is rotated, and rotated at high speed. In this respect the device rather resembles the milling machine.

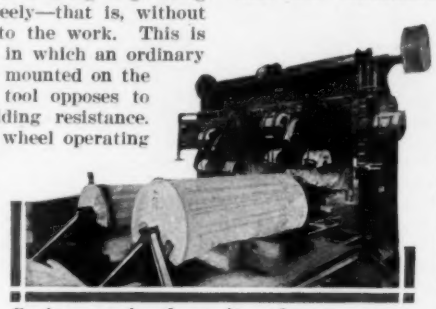
The cutting may be facilitated by dividing it into two parts. In the earlier part of the cutting, a slotting wheel is used in place of the molding wheel. This slotting device consists of a gang of coping wheels, so dimensioned as to cut circular slots in the rectangular block of stone, these slots having depths suited to the general form of the baluster desired. The molding wheel is next used. The work may now proceed more rapidly because of the preliminary slotting.

The balusters must naturally have ends perpendicular to the axis, and often the bases will have square sections. Sometimes, the block is jointed and squared before it is put into the lathe and given its complicated form. But these operations may also be done with the abrasive wheel subsequently to the molding operation. That is, an abrasive wheel two or three inches thick is mounted on the spindle which accommodates the molding wheel. It is then run at a high rate of speed and made to cut into the molded but not quite finished baluster, while the latter slowly rotates. The baluster may in this way be cut to the proper length. The squaring operation is performed on the planer. The block, now nearly a finished baluster, is put on the planer and the latter made to carry it forward beneath a rotating abrasive wheel about three inches thick. It is only necessary that this wheel shall pass over the surface a reasonable number of times, and the job is done according to the design.

The molding wheel just described is simply a complex wheel that may be used for simpler work in a simpler form. For example, wheels are given a peripheral form suiting them to cut the regulation straight molding used for decorative purposes. In this case the wheel may be only an inch or a few inches thick. The work is well managed on a planer. The rotatable molding wheel is set up at the head of the machine and the

work is sent beneath it on the platen. Where a good deal of stone has to be removed, it is possible to use a coarse grit wheel for a preliminary operation. This class of wheel is competent to do deep and fast cutting. In fact it does the roughing work and is followed by a molding wheel made from a finer grit. The wheels may be made at the factory to correspond with any design wanted, and so do not cover merely a few shapes.

A notable advance made in recent years concerns the cutting of granite and other very hard rock. In fact, carborundum has been applied to the polishing, slotting, checking and fluting of granite. The polishing by means of loose carborundum has been going on for some time. An iron or steel scroll wheel is used to provide a resistant surface. But more recently this abrasive has been found suitable in the checking or rabbeting of granite blocks, and in the fluting and jointing of granite columns. Special wheels have been developed for the express purpose of dealing with this refractory stone. One advantage of using a grinding wheel is that the wheel cuts freely—that is, without opposing appreciable resistance to the work. This is radically different from the way in which an ordinary lathe tool cuts metal from a bar mounted on the lathe. In this latter case, the tool opposes to the work a stiff, almost unyielding resistance. The advantage of a free-cutting wheel operating on granite consists principally in the fact that such action pretty well eliminates breaking or damaging the stone. In connection with fluting, the abrasive wheel is run along the sides of the location where the flute is to be and so cuts two long slots. The material in between slots is then pinched out, and the stone cutter does the remainder of the forming by hand. This work of slotting for flutes is done on the planer, the wheel being set up at the head and the work being run under it on the platen of the machine. Jointing of granite columns is done with thin, solid wheels made of the abrasive. True joints are readily made and sharp arrises formed.

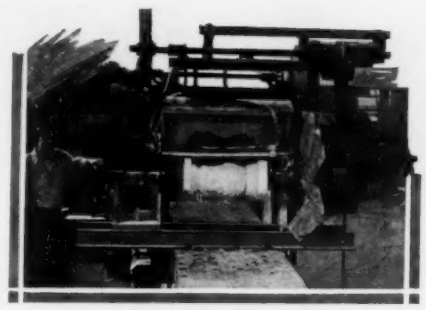


Coping a pair of granite columns preparatory to fluting. The machine does not require constant attendance

Cutting granite with a free wheel, thus having no advantage of pressure, is not the easy process that the cutting of marble is. To make a proper attack upon the hard, recalcitrant stone, a linear speed of 10,000 feet per minute is advised. The particles of granite are shut off, as it were, by minute projectiles impinging with a velocity of nearly two miles per minute. The wheels used are not necessarily large fellows. Consequently, with comparatively small wheels, it is necessary to use very high rotational speeds in order to develop the linear peripheral speed of 10,000 feet per minute.

In all the stone cutting operations, the wheels should be assisted by a jet of water. This jet impinges preferably at the point of action or very close to it, and at a pressure as high as 60 pounds per square inch. This is the pressure due to a head of 138 feet.

The accompanying illustrations show the various kinds of machinery employed in cutting and shaping stone, and also the inserted tooth stone saw with the abrasive teeth placed in dove-tail slots.



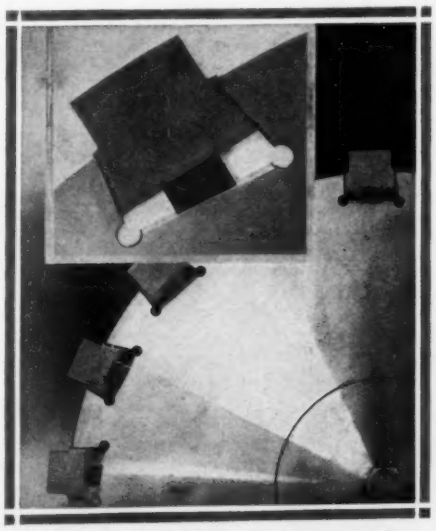
Slotting a baluster

The Physical Basis of Life

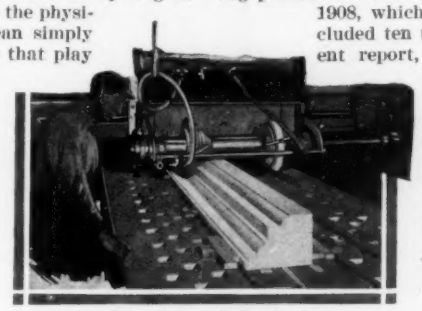
LONG ago it became perfectly plain that what we call protoplasm is not chemically a single homogeneous substance. It is a mixture of many substances, a mixture in high degree complex, the seat of varied and incessant chemical transformations, yet one which somehow holds fast to its own specific type for countless generations. The evidence from every source demonstrates that the cell is a complex organism, a microcosm, a living system. With the microscope we distinguish in this system a clear ground substance or hyaloplasm in which are suspended a great variety of formed bodies, widely diverse in form and function, each of which plays its own particular part in the activities of the system. Examples of these are the nucleus, the cytoplasmic chondriosomes, and plastids; also the Golgi-bodies and central bodies, and many kinds of granules and fibrillae. Some of them seem to be permanent, others transitory, formations that come and go in the kaleidoscopic operations of cell-life. Which of them are alive? Which, if any, constitute the physical basis of life? What, in other words, is protoplasm?

These are embarrassing questions. The truth is that the more critically we study them the more evident does it become that we cannot single out any one particular component of the cell as the living stuff, par excellence. Of this fact most experienced cytologists, including such eminent leaders as Flemming, Strasburger, Bütschli, Kolliker and Heidenhain, long since became convinced. "No man," says Flemming, "can definitely say what protoplasm is . . . In my view that which lives is the entire body of the cell." It is this view of the physical basis of life that has impressed us more and more as our knowledge of the cell has advanced; and this is as true of the physiologist and the chemist as of the cytologist. "We cannot," says Professor Hopkins, a distinguished biochemist, "without gross misuse of terms, speak of the cell life as being associated with any particular type of molecule. Its life is the expression of a particular dynamic equilibrium which obtains in a polyphasic system. Certain of the phases may be separated, but life is a property of the cell as a whole, because it depends upon the equilibrium displayed by the totality of co-existing phases." This conclusion is in substance precisely the same as that of the cytologist.

When we speak of protoplasm as the physical basis of life, therefore, we mean simply the sum total of all the substances that play any active part in the cell life; and we cannot exclude from the list such substances as water and inorganic salts which we commonly think of as "lifeless." At first sight this may seem a rather barren conclusion; but the fact is quite otherwise. No conception of modern biology offers greater promise of future progress than that the cell regarded as a whole is a colloidal system, and that what we call life is, in the words of Czapek, a complex of innumerable chemical reactions in the substance of this system. Modern investigation has indeed already profited so much by the point of view thus offered as to suggest that the study of protoplasm and the cell may be destined to pass more and more into the hands of the physiologist, the physicist and the chemist. In any case, the rising tide of cell-research in these directions is of good augury for the future experimental analysis of vital phenomena. There are, however, other aspects of the problem which still escape the precise quantitative methods of the physicist and chemist, or are only beginning to come within their range, but which are none the less essential to our view of the general problem. I refer to those phenomena with which the cytologist, the embryologist and the geneticist must try to deal.—*Abstract from first Sedgwick Memorial Lecture by Professor E. B. Wilson, delivered in Boston December 29, 1922.*



Quadrant of inserted tooth stone-saw, showing how the abrasive teeth are keyed in with wedges



Forming a balustrade

Pure Ozone

PROFESSOR E. H. RIESENFELD, of Berlin, has recently described, in the *Chemiker Zeitung* for October 7, the preparation and properties of pure ozone. Ozonized oxygen containing 10-15 per cent of ozone was liquefied in exhausted glass bulbs by cooling in liquid air. The deep blue liquid, on exposure to reduced pressure, gave off mainly oxygen, and at a certain composition separated into two layers; the upper, dark blue, layer was a solution of ozone in liquid oxygen; the lower, deep violet-black, layer was a solution of oxygen in liquid ozone. The lower layer, formerly considered to be pure ozone, contains about 30 per cent of oxygen at —183 degrees Centigrade. The oxygen was pumped off from it, and pure liquid ozone (B. P.—112.4 degrees Centigrade) obtained. The vapor density of 48 (O_3) was found by the Dumas method. On cooling in liquid hydrogen solid ozone, in violet-black crystals (M. P.—249.7 degrees Centigrade), was formed. The gas, deep blue in color, is, in the absence of all catalysts, remarkably stable. Pure gaseous ozone can be exploded by an electric spark, but some remains unchanged. This would be expected from the endothermic character of the substance. The critical temperature is 5 degrees Centigrade. No evidence whatever of the existence of higher polymers of oxygen was obtained; both in the liquid and gaseous states the formula is O_3. This work is of great interest, and, apart from the determination of the physical properties of ozone, it removes the last doubt as to the simple character of ozone—"oxozon" does not exist.

Water-Power Plants in the United States

THE United States Geological Survey, in a recently published compilation of data regarding the developed water-power in this country, shows that at present there are 3116 water-power plants of 100 horsepower or more, with a total capacity of installed water wheels of 7,852,948 horsepower. Of this total 79 per cent is in public utility plants and 21 per cent in manufacturing plants. It is of interest to note that the census of 1908, which embraced plants of all sizes, included ten times as many plants as the present report, which embraces only plants of 100 horsepower or more.

New York still maintains its position as the leading State in the amount of developed water-power, with 1,291,857 horsepower; California is a close second, with 1,149,099 horsepower; Washington is third, with 454,356 horsepower; Maine closely follows in fourth place, with 449,614 horsepower, and Montana is fifth, with 344,420 horsepower.

To permit a comparison of the developed water-power with the total water-power resources a table is included showing the maximum and minimum potential water-power of the United States.

The potential water-power of the United States was determined by dividing the rivers into sections of different lengths, the length depending on the slope of the channel, and the fall and flow of each section were determined from the best information available. With these factors the potential water-power of each stream was determined on the assumption of an efficiency of 75 per cent in the water wheels.

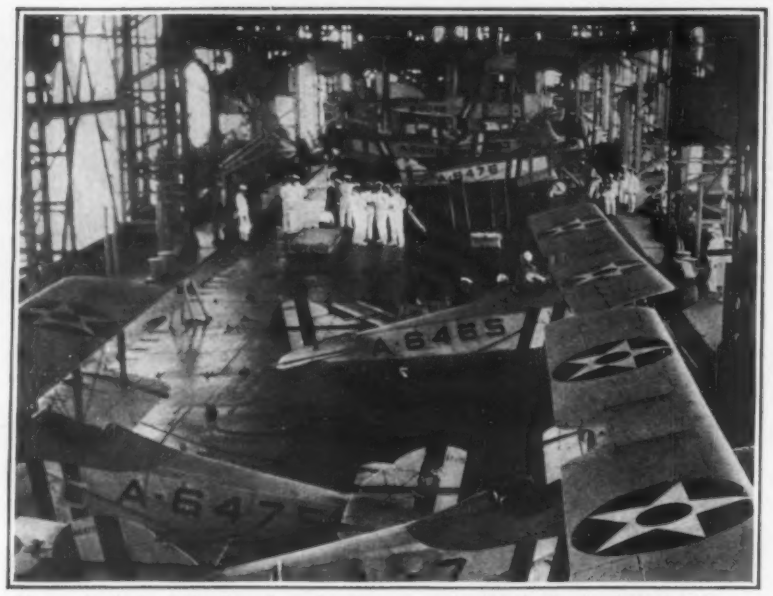
The minimum potential water-power is based on the average flow of the two seven-day periods of lowest flow in each year of record. This, of course, does not give the absolute minimum flow, but for all practical purposes potential water-power based on the flow may be considered as continuous power. The maximum potential water-power is based on the flow available for 50 per cent of the time.

It is the general practice in the construction of water-power plants to install hydraulic machinery capable of utilizing stream flow far in excess of the absolute minimum and much in excess of the flow used in determining the minimum potential water-power as given in the table. This practice is forcibly brought out by comparing the minimum potential water-power with the total capacity of water wheels installed in water-power plants in some of the New England States. If all the water-power of the United States were to be similarly developed, it would probably be necessary to install plants having three or four times the capacity of the estimated minimum potential water-power as given in of the table.—*Abstract from article in Science for January 12, 1923.*

The Airplane-Carrier "Langley"

WHEN the United States ship "Langley" joined the battle fleet of the United States Navy, she represented an old ship with a new name and an altogether new field of activity. It would take a naval man to recognize, in the "Langley" of 1923, the collier "Jupiter" of 1912. Of the original ship, only the hull and the motive power remain. Otherwise, she is a new vessel; and, so far as her duties are concerned, it would be difficult to imagine a greater change than from the carrying of thousands of tons of grimy coal to the transportation of some thirty or more trim and dainty airplanes.

In changing the ship over from collier to carrier, a clean sweep was made of all the structures above the upper deck, to make way for a broad, lofty and unobstructed flying deck. Gone are the tall masts and the long line of derricks for handling the coal. Gone also are the smoke stacks, and if someone who had never heard of airplane carriers, were suddenly to come upon the ship, she would look as though some giant carpenter had run his plane over her superstructure and then built upon the ship a vast table as broad and long as the vessel itself.



The main deck of the Langley, showing on each side the latticed steel columns which carry the flying deck above

The "Langley" will always carry, in the the annals of the navy, the distinction of being the first large, seagoing, airplane-carrier in the United States Navy; and in view of the supreme importance which aviation is bound to assume in future naval strategy and tactics, this will be no mean distinction. There is another claim to historical value which is of scarcely less importance. We refer to the fact that when, as the "Jupiter," she was put into commission, this ship carried a new type of motive power, the electric drive, which was destined to be so successful as to cause it to be adopted as the drive for all capital ships of our navy. A sister-ship the "Neptune," built at the same time, was equipped with a mechanical gear drive; and the "Jupiter" showed such superior performance that, so far as the turbines and gears built into the "Neptune" were concerned, there was no question of the superior economy and all-around performance showed by the "Jupiter."

The "Langley" is 542 feet long over all, with a beam of 65 feet and a mean draft of about 28 feet. Her turbines and electric motors operate two screws and her speed on trial was 15 knots. Her original normal displacement was about 20,000 tons. She was launched in 1912, and converted to an airplane-carrier 1920-1921. In changing the ship over to a carrier, the structures above the main deck were removed and above this deck, along each side of the ship, was erected a series of lofty lattice steel columns, with a series of transverse girders running across the width of the ship to carry the flying deck. The whole series of columns was strongly braced, both transversely and longitudinally, and upon them was built a flying deck 534 feet long with nothing projecting above its surface except two signaling radio masts which can be housed vertically below decks. To conduct the furnace gases away from the ship, two horizontal smoke ducts are provided, which are inter-connected so that the smoke can be discharged on the lee side of the vessel.

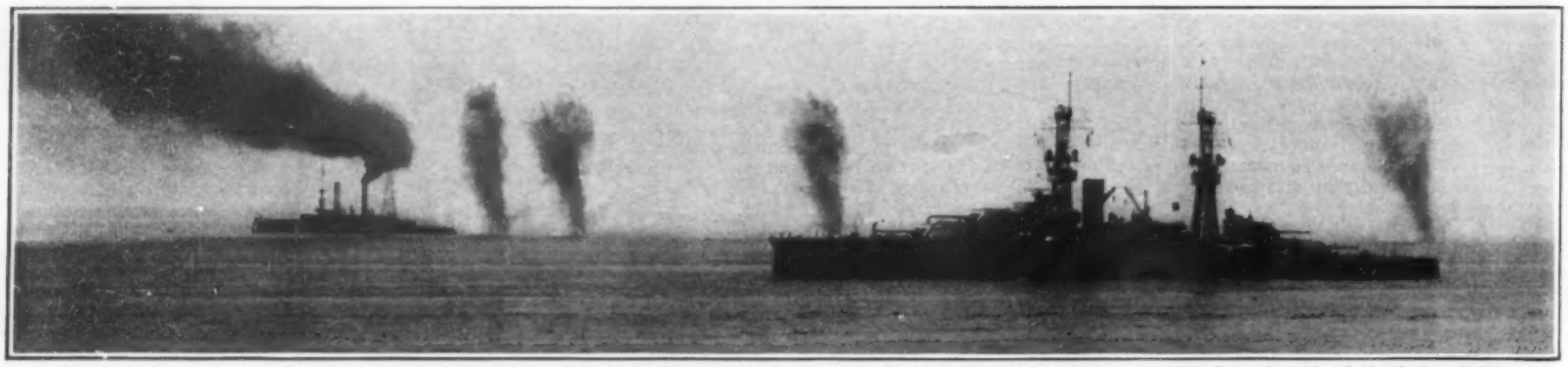
The large cargo space of the ship is available for storage of airplanes, spare parts, and the various equipment required by an airplane-carrier. There are magazines for the ammunition of the guns carried by the ship and for the bombs to be dropped by the airplanes. The gasoline tanks have a capacity of nearly 600 tons, and there are also tanks for the large amount of lubricating oil which must be carried. The tanks are served by an elaborate pumping plant, which leads to the hangars and to the flying deck.

The cargo holds have been altered so as to give the maximum amount of space for the stowage of airplanes, and the "Langley" is credited with carrying a dozen single-seater pursuit planes, a dozen two-seater spotting planes, four torpedo-dropping planes and six torpedo-seaplanes.

The illustration at the top of this page is taken on the main assembly deck below the flying deck. On each side will be noticed the lattice columns which carry the flying deck above. Attached to the girders which support the flying deck are runways, which carry traveling cranes for hoisting the planes from the hold of the ship and leading them fore and aft to the desired position. Here, after overhauling and inspection, unless that already has been done in the hold below, the runways pick up the planes and carry them to electric lifts, which raise them to the flying deck above. It will be noticed in our view of the main deck, that the planes are assembled transversely to the ship with the tail pointing inward.

One of our photographs shows a plane taking off from the flying deck during the recent manœuvers of the fleet at the Pacific entrance of the Panama Canal. Mantlets are rigged which serve to engage the airplane and bring it to rest in the shortest practicable time. It will be noticed that along each edge of the deck netting is rigged to which the operating crew can retire when the planes are flying off or flying on.

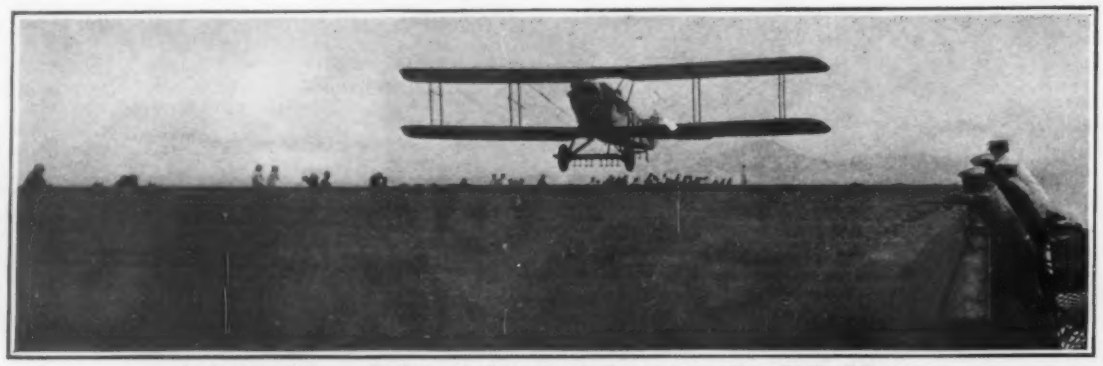
Very interesting is the central picture, showing the fall of a salvo of 14-inch shells during the bombardment of the old "Iowa"—a ship which took part in the battle of Santiago during the Spanish War. Of course, there was no one aboard the target; and she was steered from a distant ship by radio impulses, acting on electric magnets which controlled the steering gear. It should be understood that this radio apparatus had no part in the original equipment of the "Iowa," but was installed merely for target practice purposes. The "Iowa," steaming at about 10 knots, and constantly changing course, was attacked at various ranges corresponding to those which would be obtained in a modern engagement. The ship was under perfect control.



The splash of a salvo of 14-inch shells fired by the "Mississippi" against the "Iowa" (left). Ship in the foreground is observing the fall of the shells

Firing on the "Iowa" took place on two days. On the first day the "Mississippi" fired her five-inch, 51-caliber guns using thin-walled, high explosive projectiles. This firing took place at from 12,000 yards down to 8000 yards. Later that same day the "Mississippi" fired at the "Iowa" with her 14-inch, 50-caliber guns, using thin-walled, high explosive shells at an initial range of 19,000 yards, which was decreased during the run to approximately 16,000 yards. That night the "Mississippi" conducted a search operation using star-shells to locate the "Iowa," but not firing upon her. On the second day, the "Mississippi" again fired upon the "Iowa" at from 19,000 to 16,000 yards with her 14-inch guns and the thin-walled shells. Later that day, she made a second run, and administered the final blow, sinking the "Iowa." On this run firing was again opened at between 18,000 and 19,000 yards and nine five-gun salvos were fired, using service projectiles in her 14-inch guns. After the ninth salvo, the "Mississippi" ceased firing and the "Iowa" sank almost immediately.

It should be explained that the battleship in the foreground is well outside the line of fire, and is steaming along merely to observe the fall of the shots. It is interesting to notice the four geysers of spray thrown up by the shots of one salvo.



Airplane landing on the flying deck of the airplane carrier "Langley" off Panama

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

A voltmeter and ammeter for locating automobile troubles

A Combination Voltmeter and Ammeter

BY means of this combination voltmeter and ammeter any trouble in the electrical system of an automobile may be easily located. The instrument is a combination of five instruments—three voltmeters and two ammeters, and it affords a means of measuring the voltage and current of any range usually found in automobile equipment. It is provided with ammeter leads with clips for instantaneous connection and voltmeter leads having prods. For special battery tests a cadmium electrode is included. The scale has a zero center and reads in both directions so that the meter may be read whichever way the leads are connected. The needle swings toward the terminal to which the positive side of the electrical circuit is connected.

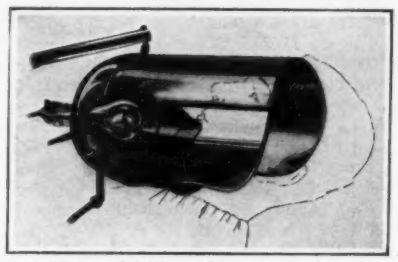
The small button in the face of the instrument is used for setting the needle exactly on zero. In making the voltmeter tests a small button at the right is turned till the line points to *V*. In this position ammeter readings cannot be taken. Four terminals are placed at the bottom of the instrument. In making ammeter tests the small button at the right is turned till the line points to *A*. This connects the moving coil to the cables at the top of the instrument and disconnects it from the voltmeter prods at the other end. As many as 30 distinct tests may be made with this instrument.

A memo clock for busy people

Radiant Heat and Steam for the Complexion

A MASK which contains an electric light for the administration of radiant heat to the face and has a connection with a steam generator for additional treatment with steam is the product of a New York manufacturer whose claim is that this combination treatment is highly beneficial to the skin. The mask is made of aluminum. It envelopes the face, which receives the radiant heat from a 60-watt lamp reflected from the polished metal interior of the mask. At the same time steam is supplied from a generator which is heated electrically from any lamp socket.

Most skin diseases, it is claimed, can be traced directly to the clogging of the pores, which prevents the blood impurities from being expelled in the natural outlet by perspiration. The virulent matter then suppurates, resulting in an eruption of pimples. The old method of using a saturated towel on the face is both unsanitary and ineffective, as by this means perspiration is not induced, the skin being only wetted. Moist heat, such as is furnished by the mask, stimulates the nerves and causes a dilation, inducing a deep flush. This brings about a sedative action which relieves tired nerves. Electric light from a white bulb destroys bacteria and acts as a tonic, while blue light constricts the blood vessels, producing an anaesthesia which gives a sense of comfort and ease.



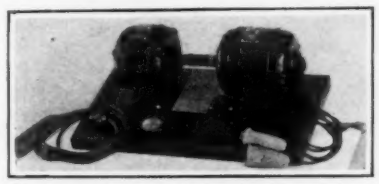
Steam-heating the complexion

A Clock That Never Forgets

MANY people have trouble in remembering appointments arising during their waking hours, and for this purpose the alarm clock idea has been extended to make possible and convenient a series of alarms or memory ticklers given as previously planned throughout the day. Such a clock, which is shown in the illustration, goes further than this; for the man who, after being reminded that there was something to be reminded of, cannot think what it is, there is provision on the clock face for inserting a number of cards opposite the hours when the alarm is to ring, each bearing a note about what is to be remembered. Thus the owner of the device, after being apprised by the bell that he has something to do now, looks at the card and discovers jotted down, "Telephone Mr. White." At 2:45 it alarms him into action and he learns on consulting the card that he has omitted to go out to lunch. Careworn commuters will no longer discover that they forgot to purchase butter for tomorrow's breakfast, for the clock will have jarred their consciousness before it is too late. This clock truly divides life into exact periods, and it will therefore meet with the wholesome approval of the very orderly, systematic person who believes in a time for everything and everything in its time. No fussing with dial indicators is required in setting this clock. The card is simply inserted in the slit at the particular 15-minute interval the alarm is wanted. Its end catches a lever inside the mechanism and sets off the alarm.

A Motor-Generator Charging Set for Radio and Automobile Batteries

A GOOD many people own radios, a large number own motor cars, and quite a few own both. Here is a charging set for the starting batteries of the car or for the "A" batteries of the radio, both of which have the good fortune to require the same voltage. The motor

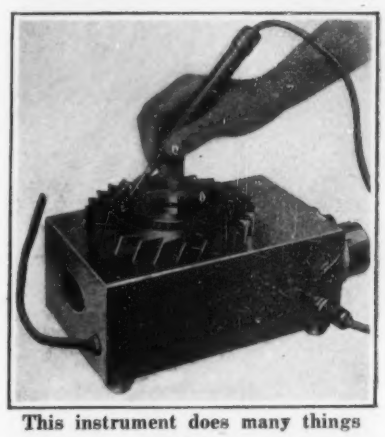


Charge your own batteries from electric light circuit

part of this set, which is the product of a Cleveland electrical manufacturer, takes the regular 110-volt pressure at 60 cycles per second, which means that it will suit the majority of electric light circuits in the U. S. A. The little D. C. generator gives current at 6 to 10 volts, and is equipped with clips ready to attach to your cells for charging. The set is provided with ball bearings at either end, which practically eliminates lubrication troubles.

Steel versus Rubber

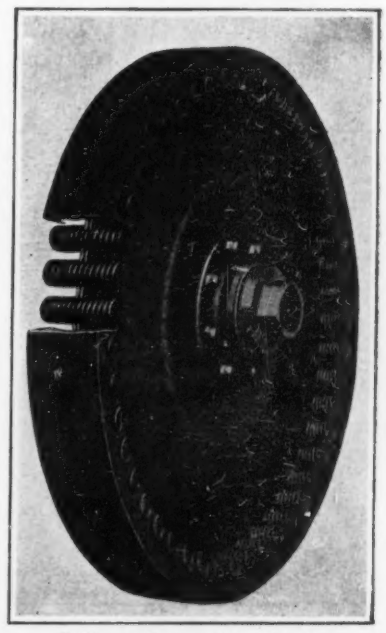
A FORTUNE awaits the maker of a vehicle wheel which has such high merit that it will supplant the rubber tired type now so almost universally in use. It is true that wheels enough to make a huge automobile of the Patent Office at Washington have been invented and patented, yet, despite all the effort thus represented the rubber tire, either pneumatic or solid, rolls majestically on. Many of these wheels employ spring elements for spokes but it has remained for Mr. W. B. Kerrick of Los Angeles, Calif., to use springs in the rim, not a rare feature, either, but in this case they are used in a truly unique manner. They take the load, not in a direction normal to the road surface, but parallel to it. The wheel consists of a steel disk into whose periphery are let a large number of spiral springs having their axes, as before mentioned, parallel to the road surface. These springs are also let into the inside of a rim having a channel cross-section. As the rim does not touch the disk, the load is continuously floated on the many transverse springs. It is claimed that the use of steel does away with much vibration as well as saving fuel, repair bills, oil and time, and that steel is not so sluggish as rubber and will last longer.



This instrument does many things

Electrical Etching, Demagnetizing and Annealing

AN electrical instrument which combines these three functions is the development of a Toledo, Ohio, manufacturer. In the process of the demagnetizing of tools which are used in connection with magnetic chucks, where it is necessary that the tools be kept demagnetized in order to be thoroughly efficient, it is only necessary to pass them longitudinally across the surface plate while an alternating current flows in the coils. The instrument receives its operating current from an ordinary light socket. When it is desired to use it as an etcher, in the marking of shop tools for instance, it is only necessary to attach the pencil cord to the connection on the instrument and write with the ordinary touch on the tool. In addition to this the instrument may be used for light annealing and soldering. In the latter case a carbon annealing point is used in place of the etching pencil and the work to be annealed is held down to the surface plate magnetically. In soldering, the instrument is used in the same manner as for annealing. After the carbon point has been applied the solder is flowed on in the usual way. The total weight is 20



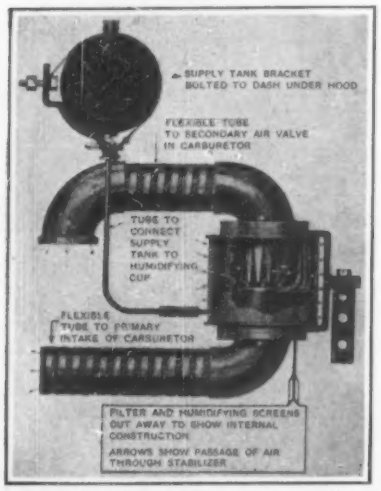
Still another spring wheel

Directing traffic with the winking glove

pounds, so that it may easily be carried about a shop to any place where it is needed.

Stabilizing Carburetor Air

COMPLETE combustion of the fuel of an internal combustion engine depends upon the use of a correct amount of oxygen as proportioned to carbon and hydrogen. The fuel for such engines is usually a combination of gasoline and air. Gasoline is a fairly stable element of the mixture, but air, furnishing the necessary oxygen, is in constant variation and unless controlled to a practically uniform content and delivery of oxygen it disturbs these otherwise proportioned fuel elements, resulting in incomplete combustion with loss of power and waste of gas. Air contains oxygen in direct relation to its density. At high temperatures it rarefies and carries less oxygen to the cubic foot, but if its density is decreased by artificial saturation, its temperature lowers accordingly and its fuel value is restored and uniformly maintained. Such artificial air saturation is accomplished, according to the claims of its Niagara Falls makers, by a device for that purpose, called an air stabilizer. As shown in the illustration, this appliance takes the air through six humidifying or saturating screens which are kept moistened by a flow of water which is constantly drawn up from a basin by capillary action. This saturation increases the density of the atmosphere, reduces its temperature, and restores its percentage of oxygen, delivering to the carburetor a supply of properly conditioned air fuel. Large savings in fuel consumption are claimed.



A new attack on the miles-per-gallon problem

The Flashing Gloved Hand

A GLOVE having attached to its back a pair of small electric bulbs, one red, one white, connected to a dry cell carried in a pouch on the gauntlet of the glove is the clever invention of an Englishman, for the use of traffic policemen. Contacts are made by closing the finger next the color of bulb wanted. The signal is eminently practical because it becomes virtually a part of the policeman and is so quickly and easily manipulated that it finds constant use. There is very little about it to get out of order, or, like many devices employing electric lights in connection with the human form, to get in the way or be too heavy for comfort.

A Return to the Steam Motor Car

THE inventor of a new type of steam boiler for the automobile sees the use of gasoline for the self-propelled vehicle as only a temporary phase in the course of its development, while the steam propelled car, because of its comparative simplicity and insensitiveness to outside disturbances, is destined ultimately to "come back." One of the chief troubles that beset the steam automobile boiler, especially in the hands of operators who are not already steam engineers, was caused by an accumulation of mud from the injected water. This often quite fairly insulates the water from the fire, permitting the part of the boiler which

This steam motor-car boiler cannot burn out

is not covered with water to reach a higher temperature than the ordinarily limiting temperature of the boiling point of water under pressure and leading to its burning out at such points. Mr. Walter B. Kerrick of Los Angeles, the inventor of a boiler made to forestall such results, states that the vertical tubes of the new boiler are all welded into a ring shaped header at the bottom. Owing to the fact that this is below the level of the fire, when it gathers an accumulation of sediment it cannot burn out. The same principle is equally as applicable to the locomotive boiler. It is stated that this new boiler has been given hard service during two years and has stood up in a remarkable manner, owing to its careful design.

Improving Radio Broadcasting

AS yet no method has been found for perfectly reproducing over a telephone transmitter or microphone all of the overtone components of the human voice and of certain orchestral instruments, like the violin, whose notes are so rich in overtones. Numerous attempts have been made and the record of these represents a steady evolution toward the desired goal of perfection. The chief trouble with the metal diaphragm has been that it has too much inertia and too little flexibility to follow the rapid vibrations made by certain of the higher notes.

The new transmitter illustrated on this page is the product of research by Dr. Phillips Thomas of the Westinghouse Electric and Manufacturing Company. Its distinguishing characteristic is its use of a direct current glow discharge at low pressure, which provides a means of ionization conduction in open air. The application of a moderately high direct potential between two electrodes separated a short distance in air, with enough series resistance to prevent formation of arc causes the establishment of a peculiar, low-current, high-voltage discharge having a glowing appearance. Such a discharge is remarkably quiet to the unaided ear. It is found that the incidence of sound waves at the gap will produce alternating potentials of equivalent frequencies. The sensitivity is surprisingly large; an amplification of ten to one will give loud signals in a headset. Draft shields are used to exclude disturbing air currents.

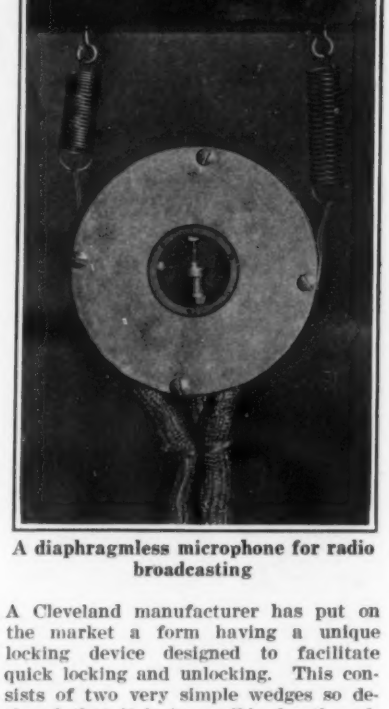
A road form that stays put in line

Locating Defective Wires

A VERY simple, though ingenious, method of locating either grounded circuits or broken wires in underground or concealed conduits has been devised by Jesse E. Debrick, assistant foreman of signals on the Pennsylvania Railroad. The device for this purpose consists of two iron rods about the size of walking sticks which are connected to the two leads from a telephone receiver. An alternating current or a pulsating direct current is applied to one end of the wire to be tested and the opposite terminal of this power supply is grounded. In case the circuit being tested happens to have an accidental ground along its length the circuit will be completed by this means and a current will flow. In testing, the operator walks along the line and thrusts his two rods into the earth at points about a yard apart. As long as he is on the feed side of the ground in the power line, a noise will be heard in the telephone receiver. The tests are continued until the sounds cease. This indicates that the point of trouble has been passed for no current is now being picked up by the telephone terminals, these having passed beyond the return earth circuit. In a similar manner an open circuit may be tested, owing to the fact that there is a condenser action between the wire and the earth which sets up a flow of current through the receiver.

A Distinctive Road Form

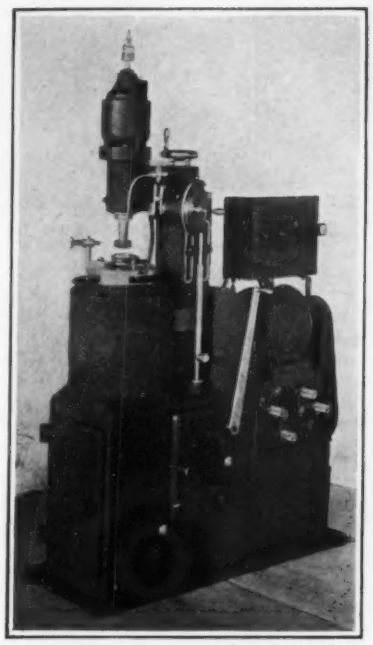
ROAD forms for making concrete curbs are usually made of metal, but there is often some annoyance concerned with the method of locking the sections together firmly, as well as in the unlocking after the concrete has set.



A diaphragmless microphone for radio broadcasting

A Cleveland manufacturer has put on the market a form having a unique locking device designed to facilitate quick locking and unlocking. This consists of two very simple wedges so designed that it is impossible for the adjacent forms to get out of line on either their bottom or face. The lower wedge resembles a rerailing frog such as is used on derailed railway trucks in that the upper wedge is almost bound to fall into the correct position with regard to the lower, no matter how carelessly they are brought together by the workman. This makes the sections of road form practically self-alining and fool-proof, and facilitates the later process of edging. The sections are 12 feet in length and are made of 3/16-inch stock. The flat holding stakes have a penetration of 18 inches and may be driven in at any point along the edge of the form. The five-inch base of the form insures an ample bearing to support it when carrying mechanical finishing and subgrading machines during the progress of the usual road-building operations.

The trouble 'phones its own location



This new machine grinds round holes accurately

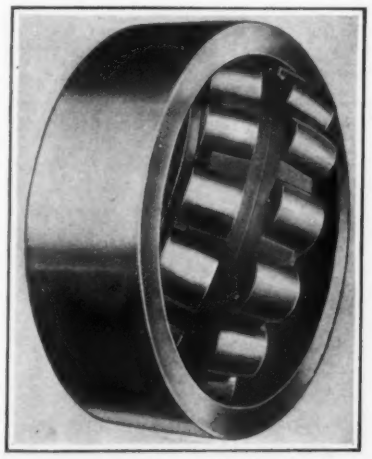
A New Internal Grinding Machine

A NEW YORK maker of machine tools has placed on the market a new grinding machine, the invention of Fred E. Bright, which embodies a new fundamental feature in the form of a revolving and reciprocating work-carrying spindle in one bearing, eliminating the necessity for its exact alinement with other essential parts of the machine. This makes possible great accuracy in the finishing of straight round holes. The machine is intended primarily for manufacturing operations and grinds cylindrical holes only.

The grinding wheel spindle is direct driven by means of an inclosed silent chain from a 1½ horsepower induction motor, thus avoiding all slippage and maintaining accurately the wheel speed. Owing to the vertical position of the spindle, floor space is conserved and the use of motor drive eliminates belts and shafting, which take up space. The machine has an automatic feed, but can be fed forward in units of one ten-thousandth of an inch. Provision is made for dressing the abrasive wheel by lowering it against a diamond. The base conceals an oil-tank, with a pump for circulating the lubricant.

Roller Bearings for Railway Cars

ALTHOUGH the roller bearing itself is not by any means new, its application to the immense amount of railway rolling stock in this country has awaited the perfection of a bearing that would stand up to the extremely heavy duty required for such work, and be as safe and as free from the necessity of making frequent repairs as the ordinary type of plain bearing. Such a bearing as is shown here is applicable to use on flywheel shafts, heavy hoisting machinery and other similar work, but its greatest potential use is for the axles of railway cars. Experiments are now being made which are rather in the nature of tests of a type of self-contained, self-alining roller bearing for regular daily railway operation on one of our most prominent railroads. The bearing has held up in satisfactory condition after eighteen months of such service. Ordinarily this would constitute a fairly conclusive test, but for railroad service extremely conservative criteria are necessary. Given practical roller bearings on our railway rolling stock, bearings that have long since passed the experimental stage and which have demonstrated their ability to take hard punishment, the saving in fuel and efficiency, not to speak of cost of freight movement, will be enormous.



A self-alining roller bearing

This unique bearing, which is made by a New York manufacturer, is self-alining by reason of its outer race, which is ground spherical on its inner surface. The rollers are barrel-shaped, with their largest diameter toward the inner ends. This permits of great freedom of movement between the inner and outer rings, which are always concentric on their bearing surfaces.

Lights Without Matches

A MINER who finds himself far from the shaft at the end of a drift without matches is almost as good as dead. If his carbide miner's light has an automatic spark light its extinction is of no consequence—a quick motion of the hand, a spark is shot across the issuing acetylene gas and there is light. This is brought about by means of a flint and scraper. Such a light as this, which is made in Chicago, should be as valuable to night hunters, woodsmen, campers and farmers as to miners, because no matter how wet or windy the night the flint will ignite the gas. The light is primarily intended to be worn on the hat where it is always directed on the thing that claims the wearer's attention, but it may also be carried in the hand or worn on the front of the coat.

An acetylene headlight with self-starter

A Trackwalker's Kit Truck

THE man who daily patrols his section of several miles of railway track is able to carry only a spikemaul and a long spanner. While these tools permit him to make most of the more urgent repairs necessary before the section gang arrives and completes the job, there are many occasions when the accessibility of a larger kit of tools would be of great advantage. But such a kit is altogether too heavy for one man to carry. From Germany comes a solution of the matter in the form of a small truck such as is used by section gangs on our own railways for moving ties over short distances. Mounted on this truck is a large toolbox containing a collection of rail repairing tools as well as an assortment of bolts, nuts, lockwashers, fishplates and spikes. This avoids the necessity of keeping these articles distributed more or less evenly along the right of way, as is now done in this country, in order that when needed by the trackwalker he is fairly sure of finding the desired replacement within a hundred yards of the job. These parts, when thus sprinkled along the track, are always subject to petty theft, as well as providing ammunition for boys with throwing propensities. When contained in the track truck they weigh one or two hundred pounds, but such a load may be pushed along the track by the trackwalker with less effort than that required for carrying the heavy maul and spanner. On the approach of a train it it is only necessary to tip the tool truck completely over, employing for this purpose the long lever ordinarily used to push the truck. The train having passed, the process is quickly reversed and the truck is again on the rails. It is provided with props so that the trackwalker may leave it standing when he stops to inspect or work.

Carries tools and spare parts for track repair

A De-bouncer for the Car

A SHOCK absorber must not deprive the springs of a motor car of their desired function of "letting the rider down easy," but they must prevent the annoying upbound which throws the rider into the air. Therefore they must act only on the upward motion of the springs, letting go instantly when the car body starts down. This function is well provided for in a type of shock absorber called a "checker," made in Cleveland for a well-known type of car. A roller acts, in this case, between the moving and stationary parts, wedging them together on the upthrow and having no function on the down-go. An adjustable spring presses down the floating wedge to the degree desired. The upper clamp is attached to the forward ends of the sills of the car and the lower one bolts around the front axle. No holes need be drilled.

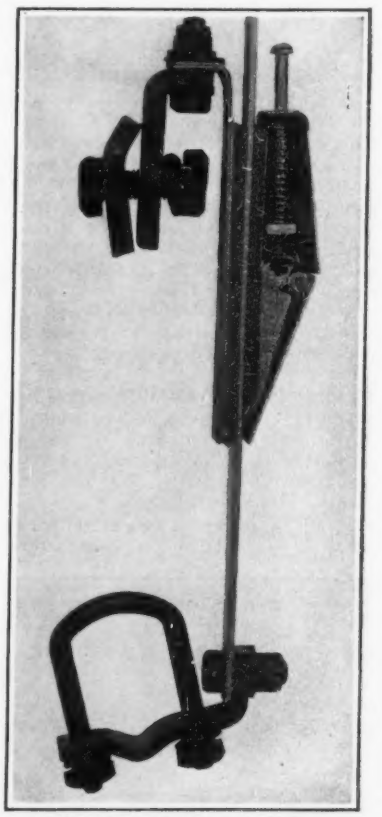
A Chemical Sponge for Refrigerators

A PIECE of charcoal will absorb 3000 times its volume of gas and it is for this reason that charcoal is often taken for stomach trouble. Material having similar chemical properties is used by a New York manufacturer for filling a neat little chemical sponge for absorbing odors in the refrigerators, where milk and butter will so quickly absorb them if the chemical sponge is not provided. The article lasts about one season, but is inexpensive. Where the ice is impure it is impossible to keep the icebox perfectly wholesome between cleanings, no matter how frequent.

Absorbs bad odors in the refrigerator

A Blueprint Dryer with Thermostatic Control

EXPERIMENTS have proved that in order to pass wet blueprints through a dryer without wrinkling, it is necessary that the heat of the drying cylinder must be constant. This is a rather difficult thing to accomplish in a perfect manner. Therefore the application of a thermostatic control to a blueprint machine by a Chicago manufacturer is a distinct step in advance. The thermostat cannot forget. It might be said to "work if you fall asleep"! It is sensitive to slight variations in temperature and catches them before they become so bad as to be harmful. The result is a blueprint of uniform texture and freedom from wrinkles. The machine has a copper cylinder which, it is claimed, will heat quicker, retain the heat better, and to which the prints will not adhere but will peel off automatically. The apron is made of asbestos and will not rot out because of wetness, like canvas aprons. The drive gives two speeds ahead, four and eight feet per minute, respectively.



A shock absorber on a different principle

This wastebasket attaches to your desk

Ball-bearings are used throughout, cutting operation costs and necessitating only a ½-horsepower motor. Gas or electricity may be used for heating.

Road Construction Turntable Speeds Up Truckwork

ON road-building jobs, owing to the narrowness of the space between the subgrades, it is generally necessary for trucks which have delivered a load of material to back up several hundred feet, or else to turn under their own power in the narrow space, which operation usually damages the subgrade. In addition, when trucks meet there is great confusion owing to the small space for maneuvers. Therefore a turntable for turning trucks, which is made in Pittsburgh, meets a need. The turntable occupies a space of eight feet at one side of the road. In turning, one end propects over the road forms. This means that an outgoing truck has free way to pass the turntable at all times, and that the forms remain in place regardless of the operation of the turntable. It is mounted on a skid which enables it to be moved from place to place without tearing up the subgrade. The turntable is attached to a returning empty truck and moved the required distance without any loss of time.

A truck, after being driven on the turntable, is secured from tipping by supports at either end of the table. When the truck is ready to be turned, a lever is operated which folds up these supports and then acts as a push-bar by means of which one man can turn a 5-ton truck loaded with four yards of material. The runways which support the truck are mounted on a circular track of smaller diameter than the width of the truck. This track is placed immediately above a similar track rigidly secured to the skids. Between these tracks is a series of rollers so that there are no axles to cause friction. A center pin rigidly secured to the skids which support the lower track holds a spider which keeps the rollers in place and also holds a central bearing for keeping the upper track properly centered.

Drying Negatives Without Clips

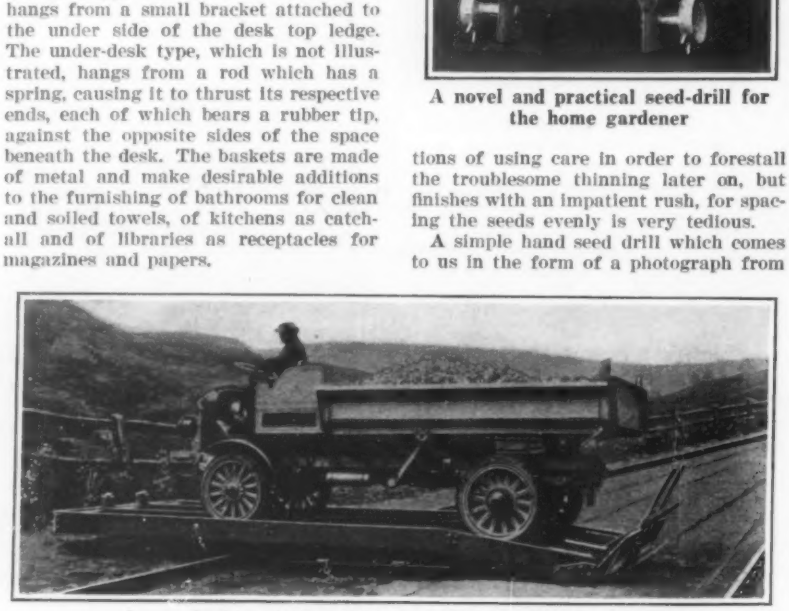
PUTTING a large number of negatives into ordinary clips for the purpose of drying them takes time and often damages the negatives by scratching them. It is much easier to pinch them between the coils of a long spiral spring made by a Philadelphia manufacturer

A simple device for holding drying negatives

for this purpose. These have room for a large number of negatives and their insertion requires only a movement of the fingers in bending the spring.

A Waste Basket for Careless Marksmen

ONE of the most irritating habits of wastebaskets is to place themselves where they weren't, yesterday or the day before. The busy office worker, without looking up, aims his waste paper where the basket ought to be and so the floor soon takes on the general appearance of a paper mill. To conquer all these annoyances a Westfield, Mass., manufacturer has devised a wastebasket which may quickly be attached to the end of a desk, or, if desired, underneath it. Here it always stands—or rather, hangs—and random shots at it hit the target because it is always there. The desk-end type shown in the illustration hangs from a small bracket attached to the under side of the desk top ledge. The under-desk type, which is not illustrated, hangs from a rod which has a spring, causing it to thrust its respective ends, each of which bears a rubber tip, against the opposite sides of the space beneath the desk. The baskets are made of metal and make desirable additions to the furnishing of bathrooms for clean and soiled towels, of kitchens as catch-all and of libraries as receptacles for magazines and papers.



A practical turntable which saves time for the contractor

A Practical Scissors Sharpener

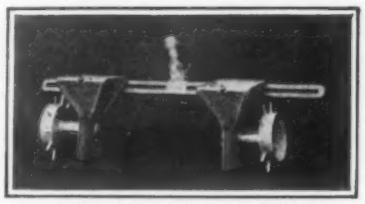
SHARPENING a pair of scissors consists in making a 60-degree cut across the edge of the blades, but it is very essential that the proper angle and no other be given. Moreover, it is necessary that the same angle be given along

With this guide anyone can sharpen scissors well

the entire length of the blade. In order to enable the scissor blades to be held at this angle, not only on one stroke of the sharpening but on every one, a Chicago manufacturer has put out a simple little device consisting of a piece of sheet metal bent in the form of a guide for the blade. This prevents the accidental ruining of the work, however carefully done without a guide, by a stroke at a greater angle with the side of the blade than the proper one. Added to these qualities is the unique fact that the device may be used in conjunction with any flat whetstone the user happens to have on hand. A woman can use this little sharpener as well as the average man; and a man can use it as well as a mechanic.

A Simple Seed Drill

FOR the average home garden a seed drill is often a luxury that seems hardly warranted by its small area, as well as an inconvenience owing to the two long handles being in the way at the ends of the short rows near the fence or wall. On the other hand, the dropping of seeds from the hand in a drill or trench is easily done poorly, but is with difficulty done well. It is as necessary to space the individual seeds somewhat uniformly and to drop them singly instead of in dense groups as it is to see that no large gaps are left. The gardener often begins the sowing of a long row by hand with good intentions of using care in order to forestall the troublesome thinning later on, but finishes with an impatient rush, for spacing the seeds evenly is very tedious.



A novel and practical seed-drill for the home gardener

A simple hand seed drill which comes to us in the form of a photograph from Germany and which is neither cumbersome nor expensive just fills the need of the small gardener in this respect. It consists of two seed hoppers which are attached to a cross-bar in an adjustable manner, permitting proper separation of the rows in sowing such vegetables as, for instance, lettuce which is grown in double rows closely spaced. In order to feed the seeds into the rows steadily and evenly a spindle passes through the throat of the hopper just above the shoe that runs along in the ground and distributes the seeds. This spindle, which is provided with the recesses necessary to contain and pass out the seeds one by one, and which is adjustable for various sized seeds, is actuated by a wheel running on the ground. To prevent it from slipping, it has around its periphery a number of spikes. A handle may be attached to the entire apparatus and adjusted to the desired angle by means of a wing nut.

A Clinging Grip on the Steering Wheel

A RUBBER grip for the steering wheel of the motor car permits the driver to retain full control of the car with little expenditure of energy, due to unconsciously gripping the wheel until the hands become tired and numb. This is especially true when the driver is wearing gloves, as the hands then slip very easily on the polished surface of the wheel. The rubber grip stretches around the wheel, fitting securely and resembling a new bicycle tire. It is made in Chicago.

A handy shaving combination

Lather: Rub-It-In

WHEN the barber lathers you he rubs it in with his fingers, but when you shave yourself and want to rub the lather in there is nothing to it but a mussy job—unless you use some such a rubber-in as shown in the picture. Here is a regular shaving brush which you proceed to use in the regular manner. Then, by manipulating a little slide in the handle, the brush is drawn into the shell, like a turtle's neck, and the lather is automatically squeezed out of the brush onto a rubber pad having dozens of little fingers. These do the rubbing. The little stud which actuates the brush in its tube locks in the desired position at either end.

A Non-Metallic Automobile Body

THERE recently has appeared a fabric type of automobile body which uses a wooden frame and dispenses with metal panels altogether. A New York textile company has produced a waterproof leather cloth of a lustrous finish, which is applied over a wooden body framework dressed with a coarse wire fabric and the necessary padding to deaden rattles and squeaks, as well as to fill out curve lines, etc. It is claimed for this new type of body, which has been shown at recent automobile shows, that the cost of the raw material is approximately one-half of that used in a metal body; that the time required in making a cloth body is one-third of that required in metal construction; that the cloth panels weigh only one-half as much as metal panels and that the finish is equal in smoothness, luster and brilliancy to that of a metal body. It is also claimed that the leather cloth lasts longer as regards finish than the usual finish of a metal job.

Radiant Type of Gas Heater

THAT the radiant type of heater was first adapted to the use of gas is the contention of a reader of the SCIENTIFIC AMERICAN, who states that the first development of a radiant heater suitable for household use was made in England two or three years before the war. This heater was equipped with gas burners which heated to a high temperature a refractory material formed in the shape of a lacework surrounding a tubular space over each flame, and raised by the flame to incandescence. However, their manufacture was stopped by the war, the factories being taken over for war work. It is said that they are now in use all over the country.

An easy way to avoid tired wrists

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

New Element, Hafnium, Discovered by English Chemist

AN English chemist has discovered a new element, which has been given the name hafnium. The element was isolated from a black sand, which came from New Zealand. This sand contained a certain proportion of titanium dioxide, and when this constituent was removed from the sand and examined by itself, it was found to contain a refractory residue. Further examination of this residue revealed it to be an oxide of a new element, closely related to titanium. The name hafnium, which is derived from the name of the city of Copenhagen (hafnia), was given the new element. It is said that the black sand deposits in New Zealand, from which the sample of sand was taken which was used in the experiments, is more than seven miles in length and of unknown depth, so that if the new metal, hafnium, is found to have important commercial properties, it can be produced in bulk. It may be of considerable value in the making of incandescent mantles, as may be inferred from its analogy to the metals zirconium and titanium.

New Steel

THE English firm, Vickers, has produced a new steel, which has the following composition: 60 per cent nickel, 12 per cent of chromium, 2 per cent of manganese, 0.5 per cent of carbon and 20.5 per cent of iron. This nickel-chrome is not oxidizable, that is, it will not rust. It was tested under the most severe conditions and was found to withstand corrosion under a pressure of 1000 atmospheres and a temperature of 600 degrees Centigrade, the duration of the test being 4000 hours.—*Chemiker Zeitung*, 1922, page 1169.

Process for Conserving Sandstone

AN interesting process for the conservation of sandstone, in which a silicate preparation was used, was described in the November 22 issue of the *Proceedings* of the Royal Academy in London.

Industrial Products From Acetylene

IN an address before a meeting of the French society, Societe de Chimie Industrielle, Prof. A. Guyot gave an interesting paper on the industrial syntheses starting with acetylene. Aldehyde can be converted into metaldehyde and paraldehyde. The latter is an important liquid fuel and should eventually reach a stage of great commercial importance because it can be produced more cheaply than alcohol derived from calcium carbide. It was also pointed out that processes were being studied on a semi-large scale to utilize the ethylene from coke-ovens for the manufacture of alcohol.

Effect of High Pressures

RECENT experiments have been made to determine just what effect extremely high pressures would have, that is, pressures reaching to 20,000 atmospheres or approximately 300,000 pounds per square inch. Under such pressures gases are caused to pass through metals, liquids become compressible and with the exception of mercury do not penetrate through metals. Under a pressure of 12,000 atmospheres paraffine and rubber become harder than soft steel and phosphorus becomes black, non-combustible and a good conductor of electricity. The new properties are stated to exist after the pressure is removed.—*Jour. Soc. Chem. Ind.*, 1923, page 80.

Making Artificial Pearls and Precious Stones

ACCORDING to German Patent No. 350,963, the interior or black surface of the pearl or stone is coated with a suitable phosphorescent material, so that color changes are produced when the pearl or stone is taken into a dim light. For example stones treated with zinc oxide containing radium exhibit a color similar to that of Guignet's green. In the case of glazed pearls, the phosphorescent coating is protected by a transparent varnish against atmospheric effects, and the glaze, if it is liable to be attacked by the radium compound, is similarly protected.

Utilizing Oat and Peanut Hulls

IN the manufacture of oatmeal and of peanut butter and oil, a large quantity of oat hulls and peanut hulls is obtained as by-products. These by-products are generally used as filler for stock feed, burned as fuel or allowed to go to waste. It has been found that a crude sugar sirup can be obtained by hydrolyzing these by-products with two per cent of sulfuric acid for two hours at a pressure of 15 pounds per square inch. After hydrolysis the acid was neutralized with milk of lime and the sugar was removed by pressing and washing the insoluble residue. About 26.5 per cent of glucose was obtained from the oat hulls by this method and about 7.6 per cent from the peanut hulls.—*Jour. Ind. Eng. Chem.*, February, 1923.

Drying Wood

ONE of the greatest difficulties in the wood industry lies in the drying of the wood, the seasoning process. Wood is difficult to dry because the small cellules deep in the wood remain alive for a long time and a living cell does not easily lose its water. It can only lose its water after it has been killed by the action of a gas or vapor. Accordingly fresh wood was subjected to the action of the vapors of benzine in an autoclave. The cellule was killed in this manner and under the action of hot air the drying of this wood then took place very rapidly.—*Jour. Ind. Eng. Chem.*, February, 1923.

Fertilizing Forest Land

IT has been generally held that wooded land, land covered with forests, should not be fertilized for there would be no resulting increase in the growth of the trees. This has been shown to be erroneous, as treatment of such land with fertilizers containing nitrogen, potash, phosphoric acid and lime has increased the growth of trees in many cases. A test, extending over a period of 14 years, was carried out at Owing, Sigmaringen, on the slopes of the Jura Mountains, where a stretch of land that contained only a few pine trees and juniper bushes, and which had been used for some time for pasturage was divided into two parts, one of which was treated with nitrogenous fertilizer and sown with Swedish clover. Both parts were then planted with firs and divided into sections some of which were completely and others partially fertilized, while others were left unfertilized. Between 1906 and 1920 the average increase in the height of the trees in the sections treated with Thomas meal and kainite was 523 centimeters; in those treated with Thomas meal alone 513 centimeters; and in the untreated sections only 408 centimeters. Ground burnt lime by itself effected very little improvement in the growth. Trees in the sections planted with clover showed a very considerable increase in growth, especially in the first year, but the tests on the whole showed that equally good results may be obtained by the use of mixed fertilizers without a previous crop of leguminous plants.—*Jour. Soc. Chem. Ind.*, Feb. 2, 1923.

Paper From Black Butt Pulp

THIS pulp is made from a tree which is indigenous to Australia. Considerable experimentation has been done with this pulp in order to determine whether it is not possible to use it in the place of sulfite pulp, which at the present time is imported into Australia. It was found that 65 per cent of black butt pulp, 25 per cent of imported sulfite pulp and 10 per cent of waste paper made a very good grade of cream colored laid paper. Black butt timber gives a higher yield of pulp per cord than any other wood used at the present time for pulping purposes. Furthermore, the treatment is comparatively low.—*The World's Paper Trade Review*, Dec. 29, 1922.

X-Rays Used to Activate Catalysts

WHAT appears to be a new use for X-rays or Roentgen rays is discussed in the *Zeitschrift fuer Elektrochemie*, 1922, pages 472-3. Platinum catalysts, such as are used in the contact process of making sulfuric acid, are subjected to the action of the rays. They are made more active, so that the production of the acid is increased to a material degree. At a temperature of 400 degrees Centigrade, for example, the yield of sulfur trioxide increased from 94.6 to 95.9 per cent and at 260 degrees Centigrade from 35 to 51 per cent. The activation is not permanent but gradually disappears within 24 hours after the catalyst has been treated with the rays.

Erasing Inks

AN interesting account of inks and their erasibility is given in the Anales asoc. quim. Argentina, 10, 220-8, *Chemical Abstracts*, 1923, 476. The only indelible inks are those containing carbon. It was found that solutions of potassium permanganate followed by sodium hyposulphite are much better ink eradicators than sodium hypochlorite and oxalic acid, as are commonly used. The former eradicator will work on aniline inks which the latter sometimes does not eradicate.

New Weapons for Boll Weevil Fighters

THE fight against the cotton boll weevil, which causes stupendous damage to the cotton crop each year, the combat to exterminate the "billion dollar bandit," as it is called, goes on uninterruptedly. Recently new weapons have been developed to assist in this perpetual battle. For one thing poison gases the military weapon, developed during the war, will be utilized for peaceful purposes in the warfare on the boll weevil. Another suggestion was the use of X-rays stored in chemical salts and applied by adhesive mixtures to the bolls and squares of the cotton plants to sterilize the eggs of the insects.—*Oil, Paint and Drug Reporter*, Feb. 26, 1923.

Motor Fuel From Vegetable Oils

VEGETABLE oils can be converted easily into gaseous and liquid hydrocarbons by subjecting the former to catalytic processes. The gaseous products are hydrogen, methane, etc., while the liquid products, after neutralization and hydrogenation, form a mixture containing appreciable amounts of benzene, toluene and meta-xylene. This forms a good motor fuel with a very agreeable odor.

Sugar Cane Alcohol, a Gasoline Substitute

ACCORDING to the *Oil, Paint and Drug Reporter* of March 26, 1923, sugar cane alcohol is used in South Africa as a substitute for gasoline. It is claimed to give more power than gasoline and to enable the engine to be started more easily. The engine will start quickly in cold weather.

Self-Lubricating Gasoline

ACCORDING to the *Engineering World*, March, 1923, a self-lubricating gasoline has been developed in California, which possesses certain advantageous properties to recommend it to the motor car owner. Ordinary lubricating oil is treated with a chemical and then the treated material is added to the gasoline in the proportion of one gallon of the treated oil to 500 gallons of the gasoline. It is claimed that this product will increase the mileage obtained from a gallon of gasoline approximately 25 per cent. The lubricant, introduced in this manner, penetrates to every part of the gas engine cylinder and lubricates the upper parts of the same, which are not touched by the oil, fed to the cylinder in the ordinary manner. Friction is thus reduced to a minimum and due to the elimination of excessive heat and pre-iguition, no carbon is formed. It is claimed that the gasoline mixture develops perfect atomization in the carburetor.

Crucible Steel in a Hearth Furnace

A HEARTH furnace, which is capable of turning out a steel able to compete with high grade crucible steel, is the invention of a Swiss engineer. This furnace has been installed in a foundry in Germany. A very high temperature is attained in the furnace by the joint action of heated fresh air and gas generated in a producer. The gas is burnt most rapidly due to the hot air and the narrow flame coming from the white heat section of the producer. The whole contents of the furnace are poured out into a large ladle raised to a white heat, which enables any sample up to 1.5 tons in weight to be cast in the most complicated molds without any premature cooling. The tenacious and substantial steel castings obtained by the new process will in many cases be a good substitute for bronze as well as complicated forgings.

The Heavens in July, 1923

Something About the Methods and the Results of the Einstein Verification

By Professor Henry Norris Russell, Ph. D.

ONE outstanding achievement of observational astronomy, at the time these words are written, justly takes the foremost place in our interest. This is, of course, the precise and conclusive confirmation of Einstein's predictions by the observations of the Lick Observatory party at the Australian eclipse of last September. Full details were made public by Dr. Campbell a few days ago, at the meeting of the National Academy of Sciences, and some account may reasonably be expected by our readers.

We all know, by this time, how Einstein predicted from his theory of general relativity that rays of light passing near any gravitating mass should be slightly curved. The calculated influence of the planets is too small to measure, but that of the sun is considerable. A ray which grazes its surface should be deflected by 1.75 inches; one passing twice as far from the sun's center, by half this amount; and so on—the deflection being inversely proportional to the central distance.

Now on a modern astronomical photograph one second is a large quantity, which stands out at once in the measures, so that it might appear easy to test Einstein's prediction by photographing stars around the eclipsed sun. But the thing is not quite so simple as it looks. Granted that we have a total eclipse, observable from a region where the weather chances are good, and actually get our photographs, we find ourselves faced with a number of practical questions.

In the first place, what are the normal positions of our stars in the heavens, from which the Einstein effect seems to shift them? This we can answer by taking another photograph of the region—or better, a set of plates—at some other time of year, when the stars can be seen at night, and their light passes nowhere near the sun. We have then to compare an eclipse plate with the others, and to hunt for the shift.

But this again is not as simple as it looks, for our two pictures may not be on the same scale, owing to changes in the length of the telescope, or in the focus of the lens, making the same group of stars look bigger on one set of plates than on the other. Now the Einstein shift seems to displace the stars outwardly, away from the sun. The two displacements, however, are not alike, for the change in the telescope increases all distances on our plate in the same proportion and therefore affects the outer stars most, while the Einstein shift is greatest for the stars nearest the sun. If we measure, on our plates, some stars that are close to the sun, and others at greater distances, we will then be able to disentangle the two effects—at the cost of some loss in accuracy.

A worse difficulty arises from the refraction of light in our atmosphere, which shifts the apparent positions of the stars, some more than others, by amounts which vary with their altitudes above the horizon. To reduce this trouble to a minimum, we must take our night plates at an hour when the stars occupy, as nearly as practicable, the same apparent positions in the sky, compared with the sky and the meridian, as they did at the time of the eclipse. The small outstanding differences may then be calculated and allowed for.

The Details of an Intricate Task

So far we have assumed our instruments to be perfect, and in exact adjustment; but like all human devices they will actually be imperfect. We cannot hope to make them absolutely free from errors; the best we can hope for is to keep these errors the same at the various times when all the plates are taken—in which case an error in the position of a given star on one plate will be the same in all cases, and will drop out of the difference between the eclipse plates and the night plates, upon which difference our calculations are based. To be as sure of this as we can, every part of our apparatus—lenses, telescope-tube, plate-holders and the like—must be constructed, not merely with the utmost accuracy, but with great rigidity and stability, so that, when set up in different places and at different times, we can get all the adjustments to be in practically the same state. Any minute outstanding errors—such for example as might arise if the plate were not exactly at right angles to the optical axis of the telescope—can be allowed for in the calculations; but on this account the calculations become rather intricate, and very laborious, though they can be made as accurately as ever.

The British expeditions to Brazil and West Africa in 1919 set out so soon after the armistice that it was impossible to secure apparatus which satisfied all these exacting requirements; and the plates which they obtained, while proving beyond a doubt that rays of light passing near the sun were deflected, and to about the extent predicted, showed also some small deviations, doubtless of instrumental origin, which have given rise to much discussion (more, in the writer's opinion, than was justified by the circumstances of the case.)

The Lick Observatory expedition, with ample time for preparation and under the master hand of the veteran observer Campbell, secured equipment which answered to the most exacting tests. The lenses were specially designed to give sharp images over a wide field; the mounting was all of metal, and combined the necessary lightness with great rigidity; the instruments were pointed directly at the sun, avoiding the troubles that may arise when its rays have to be reflected from a mirror; and every part was provided with precise and ingenious means for bringing it into exact adjustment, and then clamping it firmly in place.

To secure a high sun and good chances of weather, the expedition proceeded, as all the world knows, to the almost inaccessible northwest coast of Australia, between the desert and the sea. As it was impracticable to stay there for months and wait until the same stars could be seen in the night sky the night observations were secured in the island of Tahiti, which is in almost the same latitude; and a second group of stars, which could be observed by night at both stations, was photographed on the same plates, as a check.

This careful and laborious preparation was fully justified by the results. Four excellent plates were secured during the eclipse, and as many more for comparison. Then after the astronomers returned from their journey half around the world, began the laborious and tedious work of measurement and computation—how tedious, only those who have done similar things can fully know.

From 60 to 80 stars were measured on the various pairs of plates. Each star gave an equation involving seven unknown quantities; and all these equations, for a given plate, had to be set up, combined and solved—which meant, literally, weeks of labor. The final results, however, richly justify all the pains and care. Three of the four pairs of plates have so far been worked up—independently by Professor Campbell and Dr. Trumpler; and each plate shows the Einstein effect, clearly and without question. The amount of the shift, expressed as the calculated influence for a star at the very edge of the sun, where, of course, none was observed, came out with values ranging from 1.59 minutes to 1.86 minutes for the various plates, the small outstanding differences arising from the minute and inevitable errors in the positions of the faint-star images on the plate, and in the measurement of these images. The general mean of all the results reduces to a deflection of 1.74 minutes at the sun's limb, as against 1.75 minutes predicted by Einstein. A more complete and satisfactory observational confirmation could hardly be imagined, and the world's congratulations are due, both to the great mathematician who developed the theory, and to the great astronomer who has so conclusively confirmed it.

At 11 o'clock: July 7.
At 10½ o'clock: July 14.
At 10 o'clock: July 22.
At 9½ o'clock: July 30.
At 9 o'clock: Aug. 7.
At 8½ o'clock: Aug. 14.
At 8 o'clock: Aug. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on July 7, etc.

NIGHT SKY: JULY AND AUGUST

The Heavens

The summer constellations are now seen at their best. Scorpio and Sagittarius are in the south, amid the splendid mass of star-clouds which marks the direction of the center of our galactic universe. Following up the Milky Way we come to Aquila and Cygnus, with Lyra to the west, nearly overhead; then down through Cepheus and Cassiopeia to the horizon. In the east the most conspicuous group is Pegasus; in the southwest are Virgo and Libra, with Jupiter and Saturn brightening them up; in the west Boötes and Hercules, the latter high; in the northwest Ursa Major; in the north, Ursa Minor and Draco.

The Planets

Mercury is a morning star at the beginning of the month, and rises before 3:30 A. M. He soon draws nearer the sun and passes through conjunction on the 21st, so that during the latter part of the month he is invisible.

Venus is a morning star, rising at 3:40 A. M. on the 15th, and conspicuous before sunrise. She is close to Mercury at the beginning of the month, being only three-quarters of a degree away on the 4th, but later draws off to the westward.

Mars is an evening star, and is getting very close to the sun. He sets about 9 P. M. on the 1st, and is still visible in the twilight, but by the end of the month he is lost to sight.

Jupiter is in Libra, visible all the evening and the most conspicuous object in the heavens next to the moon. Saturn is farther west, in Virgo, and comes into quadrature with the sun on the 6th, after which date he may be counted as an evening star. By the end of the month he is lost to sight shortly after 10 P. M.

Uranus is on the borders of Aquarius and Pisces, and crosses the meridian at 3:42 A. M. on the 15th. Neptune is in Cancer, and altogether too near the sun to be observable.

The moon is in the last quarter at 9 P. M. on the 5th, new at 8 P. M. on the 13th, in her first quarter at 9 P. M. on the 20th, and full at 6 P. M. on the 27th. She is nearest the earth on the 21st, and farthest away on the 7th. During the month she passes near Uranus on the 3rd, Venus on the 12th, Mercury on the 13th, Mars on the 14th, Saturn on the 19th, Jupiter on the 21st, and Mars again on the 31st.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Advantages of Bolted Chassis Parts

WHEN we remember that the frame work of the motor truck is really the foundation of the whole machine, it is surprising that so few machines show any real evidence of applied engineering thought and effort. Practically any repair man will verify this by pointing out that the average chassis coming into his hands for overhauling is as loose as the proverbial basket. In a large measure this is directly traceable to the use of rivets throughout the frame assembly, and their inability to withstand the constant racking and vibration of motor truck operation. As far as we know there are only one or two manufacturers who have given this phase of design the amount of attention it warrants. One of them, a Buffalo manufacturer and incidentally one of the pioneer motor truck manufacturers in this country, has been using a bolted frame with outstanding success for seven years.

In their method of fabrication all brackets, cross-members, supports and in fact everything attached to the frame side rails is held in place by bolts and heavy type lock-washers as shown by the accompanying illustration. The bolts are of ample size and fitted with threads which are held to very accurate limits to assure close fitting nuts. Actual service has proved through years of use and thousands of miles of travel that this method practically overcomes chassis looseness. And in event that play ever develops, it is a much more simple matter to draw up on a bolt or two than to chop out loose rivets, drill the next size larger holes and insert new red hot rivets.

Another point, which while of secondary importance in truck life is nevertheless a decided advantage, is the ease with which repairs can be made. For example, collision damage with broken fender brackets, bent step hangers or even damaged frame rails lends itself readily to dismantling and replacement, with a minimum of labor and expenditure for parts. The chief reason that this design has not been more generally adopted is the tendency of manufacturers to cut down their production costs in order to maintain the lowest possible selling price. Experience with motor trucks, however, will prove repeatedly that the cost of a motor truck is determined by its cost of operation rather than its initial purchase price. Therefore, this design is of particular interest because it goes such a long way toward eliminating this source of chassis looseness. To bear out the perfection of this design, the only passenger car using a bolted frame similar to that of the truck is a very costly English car.

Suggested Motor Truck Size Limits

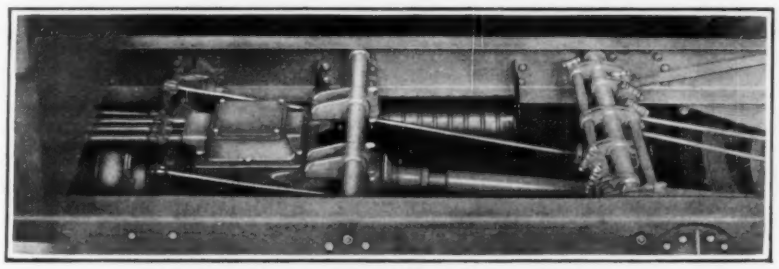
SHALL dimensions, weights and speeds of motor vehicles be reduced to the capacity of the weakest parts of the weakest highways and roads, or shall the roads be brought up to the standard of improvement adequate to carry the biggest, heaviest and swiftest loads that users of motor vehicles desire to put upon them? These are the questions asked by the Motor Vehicle Conference Committee in a digest of State laws in force on January 1, 1923, presented in a pamphlet together with a suggested code of regulations for uniform State adoption.

The committee, composed of representatives from the American Automobile, Motor and Accessory Manufacturers' and National Automobile Dealers' Associations, and the National Automobile Chamber of Commerce and the Rubber Association of America, believes that between the two extremes presented by the questions it asks a compromise will be found. This would affect the manufacturers in that they would design their products and highway engineers would build their roads in accordance with certain specifications evolved to meet the need. In regard to size restrictions the committee recommends a width, including load, of 96 inches; height, including load, of 12 feet 6 inches; length, including load, one vehicle 30 feet, combination of vehicles, 85 feet. Weight restrictions —single unit, 28,000 pounds.

Why Trucks Should be Loaded to Capacity

ONCE more in the history of the automotive industry it has become necessary for motor truck owners to plan maximum loads, if they are to care for the transportation needs of the country during the next year. It is freely admitted that there is at the present time a shortage of freight cars almost equal to the war-time lack and during the next year this shortage of transportation facilities will not be relieved to any great extent. It is apparent, therefore, that the motor truck, as before, will have to come to the aid of the railroads to meet a greater demand for movement of goods from all classes.

The railroads of the country are exerting every influence to insure that all freight cars are loaded to capacity and that empty mileage is reduced to a minimum. In conjunction with this we have many truck owners who operate fleets, such as moving vans and cartage lines and trucks for hauling farm produce to city markets. In many cases these men are operating their trucks to full capacity in both directions. But there are some truck operators, perhaps many of them, who have forgotten the return load propaganda of war time. A careful analysis of the transportation field will show them that even today we have reached such a stage in the railroad freight situation that it is impossible for business men to ship when, where, and as they like. The motor truck during 1923 can be of great aid in helping to solve this problem and there should be no trouble in securing capacity loads going and coming if a little effort is made. Such an effort is not only due the business of the country, but it is also due the truck owners. They are doing themselves an injustice when they do not carry all the goods they possibly can, in both directions on every trip. And not only are they doing themselves and their business an injustice, but their one way loads are an economic loss that affects everybody in the price to the consumer.



Details of the assembly of the bolted truck-chassis

Economy in Small Wheels and Large Tires

A NEW development appears in the automotive industry in the small diameter wheel with the large oversize tire, having, its sponsors claim, many advantages over the present sizes of pneumatic tires. It was pioneered by a taxicab manufacturing company of Chicago, which has given it a thorough tryout in its testing laboratory and also in road service because the company operates more than 1600 vehicles. The cab is built and operated on a cost-per-mile basis that is not equaled, it is said, in the automotive industry.

It was with this in view that two years ago the company started experimenting with the small diameter wheel and the large oversize tire. Today cabs going to the large municipalities are equipped with a 29-inch wheel, with either a 29 x 4½ or a 30 x 5-inch tire. Several tire companies now manufacture these sizes. In addition to these two sizes, the tire companies are conducting experiments with other sizes of big oversize tires. On a 20-inch rim the following tire size will fit: 29 x 4½ inches, 30 x 5 inches, 32 x 6 inches and 34 x 7 inches. Decreasing the wheel size and increasing the cross section diameter of the tire decreases "unsprung weight." The improved riding qualities, it is claimed, are so marked that other improvements, soon to be announced, will make the public feel that the cabs are springless. The present development marks the passing, it is claimed, of shock-absorbers, rebound checks and similar devices which have come into existence in an attempt to make driving more comfortable.

With the new type tire it is claimed there is no lost energy; every explosion is translated into travel. There is also less wear and tear on the tires. With the large new oversize tires the car, it is reported, literally floats along on a cushion of air—the resiliency is so marked that all road inequalities are smoothed out by the tires themselves. Travel over rutty country roads, it is said, is without terrors, while the danger of skidding, even without chains, is practically nullified. An additional advantage is the ease with which sand and mud can be surmounted.

In the tire size as created the air pressure is less, the life is longer and the general advantages many. A 34 x 7 tire on a 29 x 4½ rim weighs only 68 pounds including the wheel, tire, tube and flap. In experiments conducted by the cab company in Chicago 29 x 4½-inch tires have thus far given 14,000 miles of service and are still good for many more, and it is further pointed out this is regular service for these tires, not special cases picked out. Gasoline consumption in the oversize tires has been decreased from 3 to 5 miles per gallon, not only in tests with the cabs but also with passenger cars, according to the authority we have quoted.

Saving Fuel Important

THE recent stir in the daily press about the possibility of gasoline selling for one dollar per gallon has directed public attention to the necessity of saving fuel in every way possible. Here is a suggestion to drivers for the saving of gasoline which may be small in amount for a single day's run but which will be worth while in a year's driving. The common practice of waiting to shift gears on hills until the vehicle has almost come to a stop is one of the causes of waste of small amounts of gasoline. Tests were made by a government bureau primarily to discover the effect of various kinds of highway surfacing material and different grades on gasoline consumption. The conclusion with reference to faulty driving is merely incidental to the tests, but it is one which will mean a small saving to every owner, if the advice of the bureau is heeded.

The vehicles used in the tests were equipped with an ingenious device which makes a continuous record of the gasoline consumed as the vehicle moves over the road and another which makes a simultaneous record of the speed at every instant. Suitable sections of road were selected for the tests and the exact grades of these sections were determined. The specially equipped vehicles, both trucks and cars, were then driven over the various sections taking the records of the gasoline consumption and speed with the two instruments referred to. Several trips were made over each section, and the rate of fuel consumption and speed for each trip were plotted on a graph with the profile or grade of the road. It is these diagrams that show the effect of delayed gear-shifting.

Exact instructions for the most economic driving will vary with the make of the truck or car but the following pointers will be of value to all: In ascending a hill do not wait until the last second to shift to a lower gear. If you do you will not only lose speed and overtax your engine, but you will also consume more gasoline. On one of two trips of a one-ton truck the gears were shifted at a speed of 10 miles an hour and on the other at a speed of five miles an hour. In the two trips over the same stretch of road with a truck having a total weight of a little over four tons the average speed was approximately the same in both cases. In one case gasoline consumption was at the rate of 4.2 miles per gallon and in the other 3.5 per gallon. With more knowledge concerning economic driving a considerable reduction can be made in the 4,000,000,000 gallons of gasoline consumed each year.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

BUCKLE.—C. J. DAHLGREN, 212 Broadway, New York, N. Y. The object of this invention is to provide a buckle more especially designed for use on trousers and other garments, and arranged to insure a positive hold on a strap or the like and without having the points of the tongue projecting to become liable to tear overlying clothes or injuring the fingers of the user.

Chemical Processes

THERAPEUTIC COMPOSITION. — R. SANSEVERO, 167 Sterling Place, Brooklyn, N. Y. The invention relates to a composition for the treatment of diseases. The general object is the provision of a compound having bactericidal and penetrating properties for the treatment of disease by local applications. A further object is the provision of a composition which upon application liberates a penetrating antiseptic agent. The composition comprises sodium glycocholate, solargentun-squibb and hexamethylene tetramine.

COMPOSITION OF MATTER FOR CLEANING CRYSTAL AND GLASSWARE.—JULIA E. GROVER, c/o W. H. Jayne, Jr., Lakewood, N. J. The invention has for an object the provision of a composition which is economical to use, simple in preparation, and highly efficient in its cleansing and polishing function when used on glass, china and crockery. The composition is formed by mixing and boiling substantially sal soda, borax, sulfur, oil of citronella, alum, chlorinated lime, glycerine and water.

Electrical Devices

AUTOMATIC TURN-OFF SWITCH.—L. S. FOLTZ, 911 Wattaw St., Lansing, Mich. The invention has for its object to provide a switch adapted for interposition in electric lighting or heating circuits, and controlled by the passage of the current for shutting off said current at the end of a predetermined time, wherein the switch mechanism is connected to an expansion chamber which when it is expanded by heat opens the circuit.

CONTROLLING SYSTEM FOR MINE BLASTING OPERATIONS.—S. F. BRIDWELL and J. F. KENNEDY, 812 Wabash Ave., Terre Haute, Ind. The invention relates to mine blasting operations in which a plurality of blasting shots are electrically fired in the different work places of a mine at one operation. To overcome the difficulty of knowing if all the cartridges have been exploded, and thus avoiding accidents to the workmen, the system includes a telephone whereby the operator may positively know whether or not a particular cartridge has exploded.

RECEIVER. — E. REISZ, Zehlendorf-Mitte, Germany. The invention relates to electrical receivers, and has particular reference to a magnetic receiver. An object is to provide a receiver in which the disposition of the mass of the armature is disposed so as to have a maximum sensibility for a given magnetic field, and in which the vibrations of the diaphragm respond to the magnetic variations of the circuit with maximum efficiency and minimum expenditure of magnetic energy.

PROCESS OF REGENERATING LEAD STORAGE BATTERIES.—H. O. PARKER, c/o R. L. Barnum, Simpson, Kan. An object of the invention is to provide means for regenerating or desulfating sulfated lead storage batteries which have lost their efficiency, thus permitting indefinite or re-use of batteries which might otherwise be discarded. The process consists in removing the sulfuric acid, washing the batteries with pure water, filling the same with a solution of an hydroxide, and charging the battery until the solution becomes acid.

BURGLAR ALARM.—J. J. BREST, 69 Avenue A, New York, N. Y. An object of the invention is to provide a simple, compact and strong alarm device which can be readily attached adjacent any type of door, and which will be operated after having once been set whenever any person moves the door, to produce a signal, operate an electrical circuit to ring a bell, illuminate a light or perform other electrical indicating functions.

Of Interest to Farmers

SILO.—J. MATTSON, 153 W. Chestnut St., Chicago, Ill. An object of the invention is to provide a silo having a flexible closure which is supported by a rigid frame so that the closure is concave when supported by the supporting member and may be readily lifted and lowered in the silo. A further object is to provide a silo having a closure in which a door is disposed, thereby permitting access to the ensilage from the top of the closure.

ATTACHMENT FOR USE WITH TRACTOR-DRAWN BINDERS. — C. F. RIED, Palmyra, Neb. The invention relates to means for actuating the binder tilting means, the reel raising and lowering means and the bundle discharging means. The general object is to provide an attachment adapted to be interposed between the binder and tractor to be accessible by the tractorman positioned at the rear of the tractor, whereby the binder may be completely controlled, thereby avoiding the necessity of having a man on the binder.

ANIMAL POKE.—B. F. C. MORRIS, Morris Mfg. Co., El Reno, Okla. This invention has for its object to provide a device which is adaptable to various animals, which can be worn by the animal when not in operation with ease and comfort and without irritation, and which when in operation is effective to properly retard and restrain the animal. The device is simple and durable, and inexpensive to manufacture.

EGG CASE.—E. P. WATSON, SR., Bentonville, Ark. The invention relates to egg carrying cases wherein the eggs are supported in groups. An object is to provide an egg case in which bumpers are provided exteriorly for taking up a certain part of the shock when the case is dumped down, and which contains independent springs arranged interiorly to support the respective groups of containers.

BEET TOPPER.—H. L. SPARKS, Box 310, Sidney, Neb. An object of this invention is to provide a beet topper which is adapted to sever the tops of the beets while they are still in the ground. A further object is to provide cutting means adapted to sever the tops at the desired height, and to dispose of the cut tops at one side of the row of beets. A further object is to provide a cutting drum which is both simple and efficient.

CHURN.—D. AYERS and H. D. FOSSETT, Mount Vernon, Mo. This invention relates to agitators especially adapted for use as butter churns, cream whipper and the like. An important object is to provide means whereby the agitators may be applied to receptacles of various heights, and having simple means whereby the same may be applied to receptacles of various widths.

ANIMAL POKE.—D. AYERS and H. D. FOSSETT, Mount Vernon, Mo. Among the objects of this invention is to provide an animal poke having means whereby it may be detachably secured to a halter or headstall of ordinary construction and thus adaptable for application successively to a plurality of animals, and may be adjusted for application to animals of different sizes. The device tends to restrain an animal from moving too near a fence or like object.

PORTABLE COMBINED COTTON PICKING, GINNING, CONDENSING AND COMPRESSING MACHINE.—MARY W. SILVERTHORNE, Martins, S. C. The most important feature of this invention resides in the combining of cotton picking, ginning, condensing and compressing mechanism on a vehicle to render the machine portable and capable of being moved into a field as an entire unit so that the complete operations from the picking of the cotton to the bailing thereof may be finished on the field, with a minimum number of helpers, the cotton being transferred from one process to another by a continuous air current.

Of General Interest

WARDROBE TRUNK.—A. L. DUFF and J. W. MATHESON, 168 Sterling Place, Brooklyn, N. Y. The general object of this invention is to provide a trunk having means for hanging garments in the wardrobe section in a manner that the hung garments may be compact in the trunk or slid out and disposed in any one of various angular positions to be readily accessible, and having a section provided with drawers of various depths, the two sections forming a complete trunk.

CONCRETE BLOCK AND THE LIKE. —H. WILKINS, 71 Third Ave., Melville, Johannesburg, Transvaal, South Africa. The object of the invention is to provide means whereby blocks can be held together more rigidly than those at present in use, and to simplify and facilitate the construction of a building without the use of any agglomerate at the ends of the blocks which interlock owing to their shape. The invention is applicable to all forms of through cavity concrete blocks.

DISPLAY DEVICE.—L. GOODMAN and A. GOLDSTEIN, 86 W. 119th St., New York, N. Y. The general object of the invention is to provide a means in conjunction with a container for supporting goods in display arrangement so that in order to disclose the goods all that is necessary is the opening of the container. A further object is the provision of a display device provided with a plurality of supporting means for retaining the articles in spaced relation from one another so that they may be mounted for view in any desired position.

TABLE.—G. E. TOMLINSON, Winchester, Ky. This invention has for its object the provision of a collapsible table. Another object is the provision of means whereby the table top may be simply, quickly, and accurately connected and placed on the supporting leg portion and the bracing members securely locked in place so that the supporting legs are maintained in a rigid spaced relation.

AWNING.—C. B. NORVELL, 214 No. Foushee St., Richmond, Va. Among the objects of the invention is to produce an awning where means is provided for positively preventing movement of the awning in the wrong direction, thereby precluding the possibility of the awning material being torn or otherwise injured. Another object is to provide a device which is simple and durable and comparatively inexpensive to manufacture.

CIGARETTE PACKAGE.—C. E. ARNOLD, 724 "E" St., San Diego, Calif. The invention has particular reference to an attachment for cigarette packages which is adapted to be associated with the package in such a manner that the individual user may rely on the same as a convenient means of obtaining access to the cigarettes within the package when the same is first opened.

PLAYING CARDS.—R. DE W. HAAS, R. No. 1, Box 71, La Habra, Calif. The object of the invention is to provide playing cards by means of which various games may be played including practically all games to which the ordinary playing cards are adapted. While differing materially from the usual playing cards these cards are adapted to the playing of many games beyond those of which the ordinary playing cards are adapted.

SNOWPLOW.—E. LEVY, Munising, Mich. The invention relates to snow plows adapted to be drawn or pushed by a tractor. The general object is to provide a plow whereby a track will be plowed ahead of sleighs with which the apparatus is equipped. The plow is so arranged that a single operator can control the same with respect to raising or lowering the nose plow, as well as controlling either the front or back for steering.

GUIDE FOR USE IN SEWING.—MARY E. BURNETT, 210 W. Boulevard, Marion, Ill. This invention has particular reference to gages and guides and has for an object to provide a simple instrument by which the width of a hem may be readily gaged and indicated. Another object is to provide an indicator which may be frictionally held on a scale measure or bar to indicate in inches the width of the hem in ornamental stitching or like work.

PORTABLE HANDLE.—C. HAARBERG, Box 358, Fox Lake, Ill. This invention has for an object the provision of a handle which can be used to quickly and conveniently engage the wall of a box, crate or other container or article, so that the handle, when grasped by the operator is prevented from slipping, and may thus be utilized to lift or otherwise manipulate the article with which it is in engagement.

COMBINED BLOTTER AND PENWIPER.—G. B. MULLEN and J. H. MULLEN, Bell Ave., Bayside, L. I., N. Y. The principal object of the invention is the association of the elements in a convenient manner for the drying of the ink and the wiping of a pen, the penwiper constituting a convenient handle for picking up the blotter from a flat surface, such as the top of a desk. The article is simple and inexpensive to manufacture.

RETAINING RING FOR RECEPTACLE CLOSURES.—A. VAN A. FELTEN, 38 Morris St., Danbury, Conn. The invention aims to provide a cover retaining ring adapted to be utilized in connection with a receptacle including a body portion and a separate head, and the ring is of such nature that when used in conjunction with a head it causes the formation of a light seal between the head and the body at all instances. The device is of such character that when once in applied position, it will not become accidentally displaced.

SHOE TREE.—A. H. KEYS, 1672 Eddy St., San Francisco, Calif. The primary object of the invention is to provide a simple and inexpensive device, in the form of a shoe tree or support, which may be easily manipulated and capable of keeping the shoe in good shape. The device is intended to be made of a light metal and may be conveniently handled.

SHOE EXPANDING APPLIANCE.—A. H. KEYS, 1672 Eddy St., San Francisco, Calif. This invention relates to an appliance for use by individuals for expanding shoes so that the same may be made to more comfortably fit the feet, particularly in cases where persons are with corns or bunions. The device may also be used to perform the functions of a shoe tree.

FILING DEVICE FOR SOUND REPRODUCING RECORDS.—C. U. FINOCCHIARO, 1528 Amsterdam Ave., New York, N. Y. The invention has for its object to provide a filing device for sound reproducing records having two series of rods spaced apart, the rods being so spaced that records of different diameters may be conveniently accommodated. The device is not only applicable to a cabinet adjoining a phonograph, but may also be made in the form of an individual record cabinet.

SANITARY COVER FOR MILK CANS. —J. E. DACEY, 325 So. Brady St., Dubois, Pa. Among the objects of the invention is to provide a cover which may be conveniently constructed of a single piece of sheet metal and which may be readily associated with an ordinary condensed milk can and manipulated so as to occupy either closed or open position, permitting a supply of milk to be taken from the can, or when closed preventing flies or dust finding its way into the milk.

BURIAL APPARATUS.—H. H. LEAVITT, Wadesboro, N. C. This invention relates to an apparatus for use in lowering a casket into the grave, an object is to provide an apparatus by which the casket may be taken to and lowered in the grave in a solemn manner in keeping with the ceremony without the necessity of the pallbearers approaching so close to the grave as to cause caving, and which also serves as a guard to prevent the mourners from approaching too close.

SELF-SERVICE STORE.—A. W. B. JOHNSON, 1916 First Ave., Birmingham, Ala. The object of the invention is to provide a self-service store with a plurality of

compartments with service stations at the entrance and between adjacent compartments, there being a passageway in one direction at one side of each service station and passages in the opposite direction at the other sides. With this construction customers may be watched in relatively small groups by the clerks who receive money in payment of sales and who wrap the goods.

WINDOW GUARD.—T. C. RUSH, Lexington, Ky. This invention has for an object the provision of a device capable of adjustment to suit various sized window frames. A further object is to provide the guard with a form of latching and locking means for effectively preventing its unauthorized removal. The device may be collapsed so as to occupy a comparatively small space when not in use.

RECEPTACLE CAP.—E. R. MARTIN, 329 Tea Neck Road, Ridgefield Park, N. J. The invention more particularly relates to a dispensary cap for a fluid within the receptacle. The invention has reference to a receptacle cap suitable for association with any desired type of container and by means of which an operator may introduce just that amount of fluid with which a receiving receptacle should be filled, thus not necessitating the use of a stopper for preventing an evaporation of the fluid.

MAIL CHUTE.—J. J. CUSICK, 78 La Salle St., New York, N. Y. The general object of this invention is to provide in association with the letter drop of each floor of an office building or apartment house an auxiliary choke chute which will retain any matter deposited therein which could possibly clog the main chute. A further object is to afford means for ready access to the auxiliary choke chute should that become clogged.

OUTLET VALVE FOR FLUSH TANKS.—T. J. CAHILL, 810 Carrizo St., Corpus Christi, Texas. The invention relates generally to outlet valves for flush tanks of toilet bowls. The main object is to provide a valve which is constructed in such a manner as to trap a volume of air, whereby upon the initial lifting of the valve the air trapped therein will operate to buoy the valve in the water until the emptying of the tank is effected.

SCAFFOLD.—F. A. SAMPSON, Forest Lake, Minn. The invention has for its object to provide mechanism for use in connection with the usual three-cornered scaffold brackets for firmly anchoring the brackets to the wall being constructed, wherein a suitable clamp is provided for engaging the studding, the bracket having means for engaging the clamp to support the bracket.

WATCH PROTECTOR.—M. M. GETO, c/o Watch Protector Corp., 334 E. 23d St., New York, N. Y. This invention has for its object the provision of a simple device whereby the improper removal of a watch from a person's pocket is made impossible without the owner of the watch being made aware of this attempt. A further object is to provide a device which appears merely to be a neat and artistic ornament in connection with the watch chain, yet acts to achieve the abovementioned object.

SOLDERING BLOCK.—S. E. RANDALL, Box 384, Smackover, Ark. An object of the invention is to provide a simple device for holding a broken finger-ring in position to permit of the ends thereof being joined together by welding, brazing, or the like, without subjecting the stones set in the ring, or ornamental portions, to the action of the flame required for the operation. A further object is to provide a device which is adapted for use with rings of various sizes.

EXPLOSIVE CARTRIDGE.—S. DECKER, R. F. D. No. 2, Commodore, Pa. Among the objects of this invention is to provide an explosive cartridge having simple means whereby the same may be fired either by a fuse or by a needle which is engaged with one end of the cartridge so as to puncture the same. In carrying out this object the ends of the tubular body are filled with corncob plugs, through which only a slight force is necessary to puncture the cartridge. The cartridges are so constructed that they may be conveniently carried into the mine and maintained in a dry state.

SAFETY RAZOR.—F. KULHAWY, 120 27th St., Guttenberg, N. J. The invention relates to safety razors of the double-edge blade type. One of the principal objects resides in the provision of blade supporting and blade clamping members, respectively, formed at the edge with guard teeth. Another object is the provision of a razor so constructed as to permit of the arrangement of the guard teeth to properly guard one edge of the blade so that it may be used for cutting hair, while the other edge is exposed for stropping.

METHOD OF PREPARING FRUIT AND VEGETABLES FOR SHIPMENT.—T. J. PETERS, Peters, Fla. This invention has for its objects the provision of a process and apparatus for treating fruits and vegetables prior to shipment to protect them from rot and other disease while in transit. Another object is to treat fruits and vegetables with a view of hastening or retarding their maturity according to the period of transportation. The process consists of immersing the fruit in a special device containing water at 125 degrees F. or 34 degrees F. for a period of from 15 to 90 seconds.

PENCIL.—J. R. FITTON, c/o C. E. Morse, 537 W. 7th St., Long Beach, Calif. An object of this invention is to provide a pencil having a tubular barrel or casing and a novel means for projecting and retracting a removable lead beyond the forward end of the casing. A further object is the provision of a device which is simple, convenient to operate, and not likely to easily get out of order.

PROJECTING SCREEN.—J. W. PECK, JR., 900 Mansfield Road, Brooklyn, N. Y. This invention particularly relates to a screen for displaying motion pictures. The principal object is to provide a screen which includes a reflecting surface of frost or snow, said surface being formed by a refrigerating apparatus. The screen will produce an unusually fine reflecting power, and will at the same time serve to cool the house. Provision is made for keeping the surface free from dust and insuring a smooth surface at all times.

NURSING BOTTLE.—J. MAY, 2002 Hawthorne Ave., Portland, Ore. The invention relates to so-called hygeia nursing bottles and more particularly to fastening means for nipples therefor. For sanitary purposes this class of container is cylindrical in shape, and having no neck or head, the nipple employed is relatively large and will frequently leave the bottle and cause inconvenience. The purpose of the invention is to provide a fastening means for the nipples whereby every possibility of the same becoming detached from the bottle is eliminated. (See Fig. 1.)

PRESS.—A. C. VOWELL and W. O. VOWELL, 227 W. Capitol Ave., Little Rock, Ark. Among the objects of this invention is to provide a press which is adapted to be placed within a container for kraut, pickles, fruit, and the like to hold the solid contents below the surface of a liquid therein or to hold the contents in compact mass. The press is provided with means for engaging the wall of the container to releasably hold the press in various adjusted positions within the container. (See Fig. 2.)

Hardware and Tools

SHOVEL.—P. W. ELY, Jonesville, Va. The invention relates to a shovel especially adapted for removing the dust caused by cutting machines used in coal mines. The electric machines employed for forming a space beneath a quantity of coal to be blasted cause a large quantity of dust, which must be removed before the blasting operation takes place, otherwise the coal would settle on a cushion of dust and would not break up, or might cause a fire or coal dust explosion.

TRAP.—C. THERIOT, address W. M. Bowig, Atty., Houma, La. Among the objects of this invention is to provide a trap for catching muskrats or other fur-bearing animals. The primary object is to provide a trap of this character which is adapted when trapped by an animal, to close about the body, and securely hold the animal, thus preventing the fur upon the leg from becoming damaged.

DUPLEX TOOL HOLDER.—I. ERICKSEN, 1807 N. California Ave., Chicago, Ill. An object of the invention is to provide a device adapted for attachment to the reciprocating ram of a shaper or planer and provided with means for operatively engaging work during both movements of the reciprocating ram. A further object is to provide a device adapted to hold cutting tools of various kinds, whereby a "roughing" cut and a "finishing" cut may be made alternately.

HACK SAW.—N. H. COWELL and E. NIEDERMAN, 618 West 135th St., New York, N. Y. The invention relates more particularly to a hacksaw frame. An object is to provide a construction whereby different sized hack saws may be readily utilized, and to provide adjusting means for gripping and holding hack saws which have been broken off either at one or both ends, wherein not only means are provided for engaging eyes in a hack saw, but for gripping the ends and holding the same in place.

LEVEL ATTACHMENT.—L. W. TIFFANY, Winsted, Conn. It is an object of this invention to provide a device which is intended to be associated with a level, and which may be applied to any level of standard type, whereby the distance between two planes extending in a single surface may be measured. The device is especially adapted for work requiring great exactitude.

PARING KNIFE.—F. SARGENT, North Lubec, Me. The general object of the invention is to provide a device which will facilitate the paring of fruit and vegetables in such manner that there will be no waste, or in other words a knife provided with means for preventing the same from cutting too deep into the article pared. The knife is particularly designed for paring vegetables or fruit having hollows therein. (See Fig. 3.)

CAN.—M. M. SHACKITT, 236 N. Jersey Ave., Brooklyn, N. Y. The invention relates to metallic shipping and storing vessels, its object is to provide a can more especially designed for household use for ashes, kitchen refuse, and the like and arranged to provide an exceedingly strong can capable of withstanding rough handling. Another object is to permit the user to readily place the ashes or refuse into the can without removing the cover and to prevent undesirable odors from escaping.

BOTTLE CAP REMOVER.—L. A. TYLER, 23 Wilson St., Salamanca, N. Y. This invention particularly relates to a device for removing the usual paste-board cap from milk bottles, an object being the provision of a device of this character which will be entirely sanitary, which will be simple and practical in construction and inexpensive to manufacture.

EXPANSIVE DRILL BIT.—J. P. MILLER, c/o Terrebonne Gas Co., Houma, La. One of the foremost objects of the invention is to provide a drill bit, the blade of which expands when weight is imposed thereon. A further object is to provide a drill bit including a holder of collar formed with a socket provided with a slot and such an arrangement of bevels that the blades are caused to spread when slid up the slot, to drill a hole larger than the diameter of the casing in which the drill operates.

BAIL LOCK.—W. S. COLE, c/o Genl. Deliv., Johnstown, Fulton County, N. Y. The principal object of the invention is to provide means which will prevent swinging of a pail on the bail when it is being carried, and yet to provide means for permitting the bail to be swung to horizontal position when such swinging becomes desirable. A further object is to provide a bail locking device which may be applied to all forms of containers having bails associated therewith.

COMBINATION PLANE.—C. A. TRUMP, Box 37, R. F. D. No. 1, Derry, Pa. The invention relates to woodworking tools. An important object is to provide a tool which may be used as a rabbeting plane, a block plane, or a smoothing plane by a simple adjustment of the various parts. A further object is to provide a plane having simple means whereby the position of the handle may be readily changed to adapt the plane to various uses.

KNIFE.—E. LEWIS, 425 S. 16th St., Terre Haute, Ind. An object of this invention is to provide a knife of simple construction which is adapted to hold a plurality of blades in such manner as to permit of their easy removal for sharpening and replacement to operative position. A further object is to provide a knife which is adapted for use in marking, splitting and cutting composition roofing, beaver board, leather, felt or the like, and as a pruning knife for shrubbery and the like.

PIPE WRENCH.—E. J. EVANS and G. E. HEMPHILL, 313 Felt Bldg., Salt Lake City, Utah. This invention has for its object to provide means wherein the jaws of the wrench may be quickly set to engage pipes or other work of various sizes, and at the same time be brought into powerful gripping engagement with the work. Another object is to provide a wrench which is simple and durable and comparatively inexpensive to manufacture.

SAW.—C. L. ARNOLD and C. EDELEN, Bardstown, Ky. The invention relates to band saws especially adapted for use by butchers. An important object is to provide a band saw having means whereby the saw may be tensioned as the occasion requires, or disconnected for cleaning. A further object is to provide a saw having means whereby the several wheels which support the band saw may be simultaneously operated so that slipping is reduced to a minimum.

RIPSAW STICKER HEAD.—J. C. WILLIAMS, 1804 E. 55th St., Cleveland, Ohio. The invention relates to cutter heads carrying blades used in wood working. An object is to provide a cutter head which is adapted to be applied to any saw arbor of

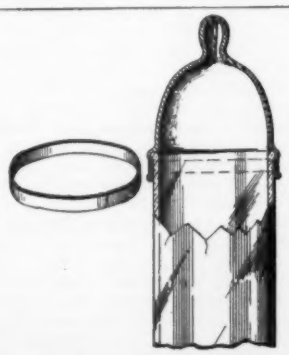


Fig. 1. This sanitary nursing bottle is the invention of J. May

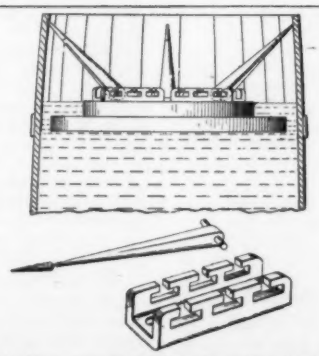


Fig. 2. This press for holding down kraut, pickles and fruit was invented by A. C. and W. O. Vowell

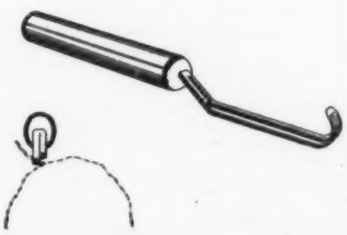


Fig. 3. Paring fruit on the safety razor principle is made possible by F. Sargent, the inventor of this knife

known construction, and holding cutters for use in producing mouldings of different configurations and for finishing strips of moulding to adapt them to be joined together by coped joints. A further object is to provide a cutter head for firmly holding blades of different sizes.

LOCK.—L. FRIEDMAN, 9 Oak St., New York, N. Y. One of the primary objects of the invention is to provide a locking mechanism of such structure as to prevent a forcing open of a door by springing the same relative to the jamb commonly known as "jimmying." A further object is to provide a lock which will automatically snap to locking position upon closing the door, and which includes a combined manual and key-operated means for releasing the lock.

FISHING TOOL.—W. CASEY, c/o J. B. Bartlett, Atty., Tulsa, Okla. The object of this invention is the provision of a tool which is adapted for connecting itself with loose material or tools which may be in the bottom of an oil well or other well of small cross-sectional area, and thereby permit said loose material or tool to be lifted. The tool is simple and inexpensive to manufacture.

LOCK.—D. E. MORRIS and T. T. MORRIS, What Cheer, Iowa. Among the objects of the invention is to provide a lock for securing together the end links of a chain, which will serve as a link for connecting together the ends of a tractor chain, or the like; and which will prevent the possibility of theft; will permit the chain to be quickly and easily detached by the rotation of a special key for engaging the latch; and which is simple and durable in construction. (See Fig. 4.)

Heating and Lighting

HYDRAULIC VALVE FOR WATER HEATERS.—W. E. KAY, 422 E. Broad St., Elyria, Ohio. The object of this invention is to provide increased practicability and efficiency, in action in a controlling valve by means of which water and gas are supplied to an instantaneous water heater or analogous device. The device is also designed with an object of overcoming the weakening or breaking of the valve operating parts.

FRUIT SIZING MACHINE.—H. B. HATCH, c/o Skinner Machine Co., Dunedin, Fla. The invention particularly relates to that type of sizing machine which embodies a traveling carrier arranged to support the fruit and carry it along until the point of discharge for fruit of a particular size shall have been reached, at this point one of the elements which support the fruit shall have moved to such an extent with relation to an adjacent element, as to permit the release of the fruit, and deposit it in that group to which it belongs.

SPINDLE PROTECTOR.—W. P. WATSON, c/o Watson Silk Co., Phillipsburg, N. J. The general object of the invention is to provide an efficient means for protecting the threads on any spindle of a spinning machine from the threads on adjacent spindles should they break. A further object is to provide a protecting means which allows the operator access to the spindles but still protects him to a certain extent from being hit by the flyer while working about the spindles.

DRAG-LINE EXCAVATOR.—A. P. STEELE, Statesville, N. C. The invention has for an object to provide a drag-line excavator for digging and loading clay or other earthy material and to so arrange the sheaves through which the cable supporting the bucket operates that the path of travel of the cable from the operating drum mechanism to the end of the boom shell have as few turns as possible, thus preventing wear and tear and effecting a saving of power.

RECORDING DEVICE FOR LIQUID PUMPS.—A. B. SNYDER, Grass Valley, Calif. Among the objects of the invention is to provide a recording mechanism for use in connection with gasoline dispensing pumps, that will eliminate all chances of error, and compel the operator to cause the sale to be recorded. A further object is to provide a dial and a hand moving over the same that will indicate the quantity withdrawn, and will automatically be returned to zero before a new quantity can be withdrawn.

OSCILLATING CYLINDER.—W. R. HOTCHKISS, 2531 University Ave., St. Paul, Minn. The invention relates to paper straightening devices especially adapted for straightening sheets of paper upon being discharged from perforating machines, ruling, scoring, or bronzing machines, printing presses or the like, the device providing a jogging movement for straightening the paper when being arranged in a pile so that it may be conveniently handled.

TUBING STABILIZER.—E. V. CROWELL, Box 1479 Station "C," Los Angeles, Calif. The purpose of the invention is to provide a stabilizer for the pipe which conducts the oil from the bottom of an oil well to the surface, and to eliminate the longitudinal stress, and the lateral vibration occasioned by the movement of the pumping valves within the tubing.

OIL BURNER.—G. M. KERRIHARD, 401 W. Coolbaugh St., Red Oak, Iowa. An object of the invention is to provide an oil burner of simplified construction which is adapted for use in furnaces of various known types of construction in which coal has heretofore been used as a fuel, and without any extensive changes, if any, in the usual construction of the furnace being required. A further object is to provide a burner in which the heavier and cheaper, as well as the lighter grades of oil may be used.

ROTARY KETTLE KILN FOR BURNING AND DRYING PLASTER STONE, PLASTER, AND OTHER SIMILAR SUBSTANCES.—G. JOURNET, Paris, France. This kiln comprises two cylindrical kettles on horizontal axes, placed one above the other in one and the same furnace, each of which revolves slowly in a contrary direction from the other. Interiorly the kettles are provided with helical wings for mixing the material and driving it towards the outlet situated in one end.

OIL BURNER.—J. H. SMITH, 92 Cypress St., Watertown, Mass. The aim of this invention is to provide an oil burner of a type which is capable of utilizing kerosene, and is also adapted for household purposes. A further object is to provide a nozzle or burner proper, capable of being utilized in connection with any type of low-grade volatile oil, but particularly kerosene, and by reason of the construction the parts will not be damaged incident to the action of the heat.

IRON PURIFYING AND BALLING FURNACE.—O. S. PULLIAM, 28th Floor, Singer Bldg., Broadway, New York, N. Y. The invention relates to metallurgical furnaces. It is an object to so construct such a furnace that the mechanism employed for bringing the oxidizing agent and the molten iron into intimate contact one with the other will be effective, and at the same time such mechanism is of a nature to properly manipulate the molten metal during the balling process.

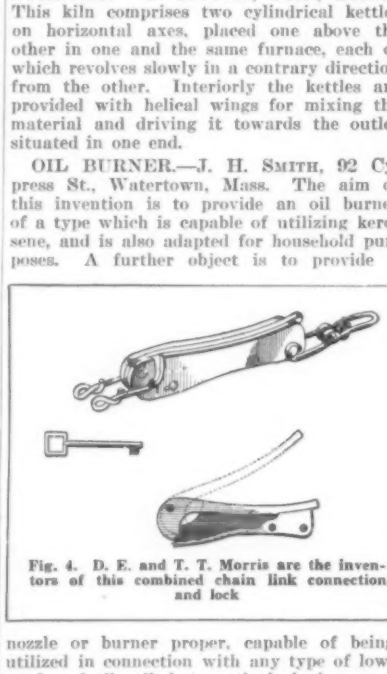


Fig. 4. D. E. and T. T. Morris are the inventors of this combined chain link connection and lock

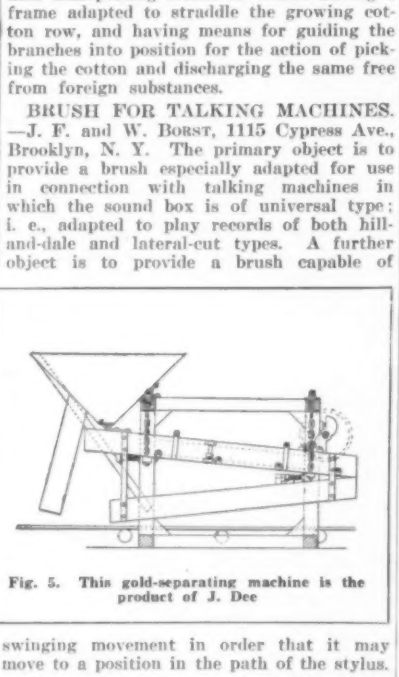


Fig. 5. This gold-separating machine is the product of J. Dee

Machines and Mechanical Devices

CUTTING APPARATUS.—A. W. HOUCK, address Edmond Rushmore, c/o Spanish-Am. Fruit Co., Singer Bldg., Broadway, New York, N. Y. The invention aims to provide a cutting apparatus for use in the canning industry where spherical edible objects, such as fruit and large vegetables, must be cut up into fifths, quarters, thirds or other subdivisions in order to obtain parts small enough to be properly packed in commercial sized cans or jars, and wherein the object is passed through the cutting machine which makes the subdivisions simultaneously.

WATCH.—J. V. ORR, Box 146, Monroe, Wash. An important object of the invention is to provide a watch having means whereby the second hand may be set at 60 so that when the hour and minute hands are set the second hand will be in exactly the right starting position. The setting mechanism does not in any way interfere with the operation of the watch or place an excessive strain on the same.

GREASE CUP.—C. C. HAMILTON and J. HUTCHINSON, Box 80, Gull Lake, Saskatchewan, Canada. Among the objects of the invention is to provide a grease cup in which the body portion carries a spring member adapted to engage a detachable cap in such manner as to prevent retrograde movement of the cap relative to the body portion on account of vibration, and having means for guarding the inlet end of the discharge portion to prevent the passage of solids or semi-solids which would obstruct the feeding of the lubricant.

SAWING MACHINE.—C. F. REICHSTEIN, Medford, Ore. The invention particularly relates to a machine for sawing fire-wood. The purpose of the invention is to provide a machine which is adjustable to saw the sticks into twelve or sixteen-inch lengths, although the machine may be adjusted to cut the sticks into blocks of any required stove length. A further object is to provide a machine capable of being operated by a single individual.

MECHANICAL COTTON PICKER.—R. G. RYCROFT, Greenfield, Okla. The special object of the invention is to provide a machine adapted to gather the exposed lint or lock of cotton, leaving the boll and other parts of the plant, as well as foreign matter free, the cotton picker consisting of a suitable transporting means or vehicle having a frame adapted to straddle the growing cotton row, and having means for guiding the branches into position for the action of picking the cotton and discharging the same free from foreign substances.

BRUSH FOR TALKING MACHINES.—J. F. and W. BORST, 1115 Cypress Ave., Brooklyn, N. Y. The primary object is to provide a brush especially adapted for use in connection with talking machines in which the sound box is of universal type; i. e., adapted to play records of both hill-and-dale and lateral-cut types. A further object is to provide a brush capable of swinging movement in order that it may move to a position in the path of the stylus.

AIR LIFT FOR AGITATORS FOR ORE AND OTHER MATERIALS.—G. T. GERINGER, Rio Gurnobatan, Masbate, Philippine Islands. A specific object of the invention is to provide a device for aerating, agitating and transferring liquids or a mixture of liquids and solids from one container to another. In this device, the power of transmission through the air line is effective. The wear is slight, and regulations can be very simply effected. In addition there are no moving parts to watch and lubricate.

MILLING MACHINE.—C. KUSOLD, c/o Kinda, 320 E. 27th St., New York, N. Y. An object of the invention is to provide a device comprising but few parts which can be attached to milling or similar machines whereby threads may be produced by a very simple adjustment of the parts without the necessity for changing the parts or changing gears to produce different threads or spirals as is the usual custom.

THREAD GUIDE FOR REWINDING MACHINES.—E. E. KAUFMAN, 573 Prescott Ave., Scranton, Pa. The invention relates to thread guides for rewinding machines and has for its object to provide a construction which may be used on old or new spindles. A further object is to provide a simple construction in the form of a removable knob for holding the thread guide structure in place which may be applied to spindles of different sizes and removed readily without injuring the spindles.

PACKER PLUG.—M. E. INSKEEP, Seal Beach, Cal. An important object of the invention is to provide a packing plug having means whereby the same may be anchored in an oil well casing after a quantity of cement has been forced into the casing to close the cavities adjacent the lower end of the same, whereby the oil is prevented from flowing upwardly between the wall of the well and the wall of the casing, the packing may be anchored a predetermined distance above the lower end of the well.

GRAIN AND SEED CLEANING MACHINE.—J. HAUGHOM and A. N. FOSS, R. No. 3, Fargo, N. D. The invention relates to a separator or cleaning machine for grain and seeds, the object being to provide a seed mill or separator adapted to thoroughly clean the seed of all straw or chaff or like particles. A further object is to so construct the riddle screens of perforated sheet metal, that the mesh or size of the openings may be varied according to the grain to be cleaned, thus adapting the device for cleaning flax, wheat, clover, and timothy or other seed or grain.

CONVEYER.—G. HAISS, c/o Haiss Mfg. Co., 141st St. and Rider Ave., New York, N. Y. Among the objects of the invention is to so construct a support or framework for endless conveyers that the side spillage of the conveyer belt is prevented from entering upon the inner surface of the lower flight to a position where it can be conveyed to the supporting rollers of the belt, and to provide a frame-lifting mechanism by means of which the angle of elevation may be varied within certain predetermined limits.

REFILL CARTRIDGE FOR LUBRICANT GUNS.—A. E. SIMMONS, 1216 8th St., Eureka, Cal. The principal feature of the invention resides in an arrangement whereby lubricants for grease guns may be conveniently vended in a package which is suitable for use in combination with the cylinder of the gun for conveniently effecting a transfer of the lubrication from the package to the gun cylinder.

BORING MACHINE.—J. A. MACEY, 834 Scott Ave., Kansas City, Kan. This invention is especially adapted for use in reboring cylinders of engines. An important object is to provide a portable machine having a plurality of radially arranged cutters adapted to uniformly engage the wall of the cylinder and which will not make a deeper cut than desired. A further object is to provide a machine which may be readily attached to a cylinder and adjusted for operation.

ROAD AND STREET CUTTER.—A. ZILBERSHER, 42 W. 57th St., New York, N. Y. An object of the invention is to provide a cutter for asphalt roadways, wherein a structure is presented which will readily cut the roadbed when pressed by a roller or other weight, the arrangement being such that small sections may be cut, so that the surface may be readily removed, and the new asphalt placed therein.

CONTROL APPARATUS.—T. MCLEOD, 534 East Jersey St., Elizabeth, N. J. This invention is designed more particularly for embodiment in the control apparatus for steering gear and has in view to so manipulate the device that the restoring of the parts to the exact position desired will be insured. The object is accomplished through an arrangement insuring a balance of pressure in the chambers of the device so that the steering gear returns unfailingly to position after an operation.

CAN SEALING MACHINE.—M. E. JOHNSTON and J. O. JOHNSTON, address James O. Johnston, Troutmans, N. C. An object of this invention is to provide a machine which will be relatively small and compact, and which will efficiently seal cans in a sanitary manner. A further object is to provide a machine in which the can is stationary and clamped between a base plate and a seaming chuck having rotary head carrying seaming rolls operated in a manner to perform the sealing operation.

COMBINED NAPPER AND SHEARING MACHINE.—M. POETZSCH, 91 Overbrook Rd., Ridgewood, N. J. The invention has for an object to provide a construction wherein the handling of cloth is reduced to a minimum. Another object is to provide a combined napping and shearing machine wherein any desired number of nappers may be used with one or more shearing devices, so arranged that there will be a continuous operation of the cloth, and wherein the napping and shearing is done in a single operation.

GOLD SEPARATOR.—J. DEE, c/o F. McNutt, 17 Laidley St., San Francisco, Calif. This invention has for its particular object to provide a gold separating machine adapted to receive gold containing material and to treat the same while it passes through the machine in such manner that particles of gold are separated from other and lighter particles, and gathered in such manner that they can be withdrawn separately, for being subjected to further processes. (See Fig. 5.)

TOBACCO TREATING MACHINE.—H. GUTMAN, 941 So. Clarence Ave., Oak Park, Ill. An object of this invention is to provide a process for mechanically treating tobacco leaves, whereby the necessity for removing the stems and midribs prior to their further use in manufacturing cigars, smoking tobacco, and the like, is obviated, thus effecting a considerable saving, not only in the cost of manufacturing the article, but in time saved in the operation.

AUTOMATIC OIL FEEDER FOR SILK-CONING MACHINE.—M. MORRELL, c/o G. W. Carlucci, 1939 52d St., Brooklyn, N. Y. The invention relates particularly to an oiling device for machines known as silk coning machines, and has for an object to provide a construction which will automatically oil the silk as it passes through the machine, and working in such a manner that an even quantity of oil is supplied to the silk thread throughout its entire length.

FRUIT GRADER.—L. H. BALWICK, 5464 Bond St., Oakland, Calif. The particular object of the invention is to provide a continuous grader for fruit, of large capacity for a comparatively small size. A further object is to provide a grader that will handle cut fruit, as for instance peaches or pears as effectively as whole fruit. A further object is to provide a grader that will not damage the fruit in any way during the grading operation, and may be adjusted for grading practically all kinds of fruit.

COTTON MACHINERY.—J. L. HART, c/o Hart Cotton Machine Co., Chickasha, Okla. The invention relates more particularly to a saw adapted to be employed in the manufacture of cotton to separate the cotton from the other substances with which it is associated, such as hulls, seeds or foreign matter. The object is to provide a device of this character of simple and durable construction, and comparatively inexpensive to manufacture.

MOLDING MACHINE.—J. F. CALDWELL, 729 So. Bonnie Brae, Los Angeles, Calif. This invention especially relates to molds adapted for use in the manufacture of gypsum blocks used for partition walls and other exterior work. The object is to provide a simple and reliable means whereby the blocks upon being formed may be removed from the mold without the possibility of breaking or adhering to the wall of the mold.

GATHERER.—A. E. PEARSON, Box 534, Littleton, N. H. An important object of the invention is to provide a sewing machine gatherer having means for gathering the finger of gloves and other pieces of work so that the same will be in proper position for sewing. A further object is to provide a gatherer which may be readily and conveniently applied and which may be thrown to an inoperative position when not in use.

ENGRAVING MACHINE.—B. R. CORLEY, c/o Turner Bros., 409 Pearl St., New York, N. Y. This invention relates to a machine using a needle for engraving letters, numerals and other characters on a coated plate, and includes a manually controlled transmitter carrying a stylus used for tracing the desired character on a master plate. An object is to provide means to enable the operator to accurately space the letters or characters irrespective of their width and shape, and to engrave the same in a straight line or an arch line. A further object is to permit of proportioning a character to be engraved to any desired width.

COIN WRAPPING DEVICE.—L. E. PARKER, Wadsworth, Ohio. The general object of this invention is to provide a simple and efficient device for wrapping coins which will allow the wrapping operation to be performed quickly and will produce a neat package. The object is accomplished by providing a device including means for rolling the wrapping means into a cylindrical form and supporting the same in conjunction with a coin guiding means.

SHUTTLE PRESSURE INDICATOR.—L. J. MCCORMACK, Washington Ave., Dumont, N. J. Among the objects of the invention is the provision of a shuttle pressure indicator that may be mounted in a shuttle to record the strength of the strokes delivered by the picker sticks to provide means for guiding the operator in equalizing the strokes and in adjusting the machine so as to give the required stroke, thus greatly reducing the wear and tear on the machine.

OIL WELL DRILLING MACHINE.—H. C. BREWSTER, c/o Oil City Iron Works, Shreveport, La. An important object of this invention is to provide a drilling machine having simple means whereby one of the sections of the drill stem may be rotated with relation to the other sections. A further object is to provide a machine embodying inner and outer tables and means for holding the inner table against rotation so that the outer table which is operatively connected with the upper section of the stem may be turned with relation to the lower section which is held against rotation.

PISTON AND PISTON RING.—I. CISSKI, 5838 E. Green Lake Way, Seattle, Wash. This invention has for its object to provide a single piston ring for a piston which is particularly efficient in preventing any gases from escaping from the combustion chamber and which at the same time will exercise a constant control over the oil admitted between the piston and the cylinder wall.

CHARGING DEVICE.—A. J. CLAUSEN, 1552 Lake St., San Francisco, Calif. The invention relates to road paving machines and is designed as a convenient means for picking up a load of loose material such as gravel or sand, lifting it to a desired height, carrying it to the paver or mixing machine, and dumping it into the same. The object is to provide means which will allow trucks to dump the material at any convenient distance from the paver, from which the charger will pick it up and throw it into the paver when the machine is ready.

Medical Devices

DOUCHE.—C. E. SIMS, 508 W. 9th St., Cisco, Texas. The invention has for its object to provide a douche especially adapted for home treatment, wherein a pipe or nozzle is provided adapted to be interposed into the cavity to be treated, and having a base for closing the cavity, and in connection therewith a speculum for spreading the walls of the cavity to insure the thorough application of the medical preparation.

Musical Devices

MUSICAL INSTRUMENT—W. BARTHOLOMAE, c/o Bar Zinc Toy Mfg. Co., 83 Greene St., New York, N. Y. The invention relates more particularly to instruments using tubes as the sounding members, the arrangement being such that either a striking hammer may be used for producing the desired sound or substantially an ordinary keyboard with an action associated therewith. The object being to provide an instrument which is simple, and with a minimum number of parts for securing the desired result.

WOOD WIND INSTRUMENT.—R. S. FORREST, Rockford, Mich. This invention has reference more particularly to a clarinet of the Boehm type, in this particular type various tones can be produced in several ways which sometimes become confusing unless the player is very expert. The object of the present invention is to simplify the manipulation of the pads.

FLUTE OR SIMILAR MUSICAL WIND INSTRUMENT.—W. BARTHOLOMAE, 83 Greene St., New York, N. Y. This invention relates to clarinets and flutes, its object is to provide a flute or similar wind instrument arranged to permit of securely attaching the mouthpiece to the tube in a very simple and inexpensive manner and without resorting to soldering as now generally practical. Another object is to insure a firm, close fit of the mouthpiece on the player's under lip.

SOUND CLARIFIER.—C. W. JOHNSON, 126 W. 98th St., New York, N. Y. The object is to provide a sound clarifier more especially designed for use in the amplifying chamber of a phonograph and arranged to eliminate dead air spaces and to insure a circulation of live air throughout the length of the amplifying chamber, to induce clarification of the sounds and to avoid muffling of the same.

DEVICE FOR ADJUSTING VIOLIN BOWS.—C. SAMPIETRO, 461 Barbey St., Brooklyn, N. Y. Among the objects of the invention is to provide means whereby a pupil or a user of a bow can simply and easily adjust the hairs to a definite tension regardless of the atmospheric conditions or other conditions which might tend to vary the tension of the hairs. The means of adjustment can be applied to any type of bow with a minimum amount of alteration.

Prime Movers and Their Accessories

REDUCTION GEAR.—M. J. WACLAW, 649 E. North St., Bethlehem, Pa. The invention particularly relates to the reduction of speed of steam turbines and free from the difficulties and objections necessarily incident to toothed gearing systems which ordinarily are used in connection with steam turbines for reducing speed. The stated object and others are attained by a flywheel and a set of magnetic rollers adapted to exert a reducing influence on the flywheel at the rim thereof.

VAPORIZER.—E. G. BALLENGER, 805 Healey Bldg., Atlanta, Ga. The invention aims to provide a vaporizer for internal combustion engines by means of which a uniformly efficient mixture will be produced at all times, which will serve to insure a minute subdivision and breaking up of the particles of the mixture, and by means of which the mixture will be heated in an extremely efficient manner so that a fluid embodying high explosive qualities will be produced.

MOTOR METER.—W. H. MANNS, 6165 Norton Avenue, Cleveland, Ohio. The invention relates to means for indicating the condition of an internal combustion engine which can be quickly and readily attached to the cooling apparatus of the engine. An object is to provide a device particularly adapted to be attached to the radiator for a liquid-cooled internal combustion engine to instantly indicate changes in the temperature of the cooling fluid.

ROTARY VALVE FOR INTERNAL COMBUSTION ENGINES.—A. E. OLSON, R. No. 4, Browerville, Minn. An object of this invention is to provide a rotary valve construction and controlling mechanism therefor, whereby the period of exhaust and intake of an engine may be accurately controlled. It is also an object of the invention to provide a construction, whereby the time at which the exhaust and intake of an engine occurs may be accurately controlled, and to provide a construction which may be operated from a remote point.

ENGINE CYLINDER AND HEAD.—D. O. BARRETT, P. O. Box 350, Springfield, Ohio. The invention relates to internal combustion engines, and has for an object the provision of a construction whereby the cylinder may be removably connected to a bed in such a manner as to be quickly removed or replaced. A further object is to provide an overlapping structure for the cylinder bed and an overlapping structure for the cylinder and head whereby the packing gaskets are prevented from blowing out.

INTERNAL COMBUSTION VALVE.—V. W. PAGE, Melrose Ave., Stamford, Conn. Among the objects is to provide a valve mechanism of the overhead type especially adapted for use in connection with air-cooled motors, and to provide an adjustable mechanism by means of which the throw of the valve may be varied, and to so construct the mechanism that the valve stem may be properly cooled during the operation of the motor.

SUCTION MUFFLER.—A. J. CHARLTON, Lowden, Iowa. An object of this invention is to provide a suction muffler for internal combustion engines that can be easily made from the types of mufflers already on the market, preferably the Ford type. A further object is to provide a suction muffler having a plurality of mechanically rotated propeller blades, which when revolved, create a vacuum in the exhaust pipe, thus obviating back pressure.

TIMER.—L. J. BAIR, 42 W. 39th St., New York, N. Y. The invention relates to timers for internal combustion engines which is simple, strong and which will have positive operation continuously. An object is to provide a timer for Ford automobiles in which a sliding contact is arranged between the contact post and the rotor whereby an even wear is produced on all the parts and whereby there will be no jumping of the contact brush and adjacent the contact section of the rotor.

VALVELESS TWO-STROKE CYCLE INTERNAL COMBUSTION ENGINE.—F. H. HENRIOD and P. HENRIOD, Yverdon, Canton of Vand, Switzerland. The two-cycle engine of these patentees is distinguished by characteristic features embodied in an engine having cylinders each composed of a motor cylinder body and a cylinder body in which the preliminary compression of the explosive mixture takes place before being passed to the cylinder body of the other motor cylinder. The passages through which the explosive mixture passes are so formed that the travel of the mixture from one cylinder to another is reduced to the minimum to promote efficiency in the operations.

Railways and Their Accessories

METAL TIE.—W. L. VARNER, 412 Elder Avenue, Pratt City, Ala. An object of this invention is to provide a simple and effective means for supporting a pair of rails in parallel relation and for securely holding the rails to gauge and against spreading. A further object is to provide a device which permits of longitudinal movement of the rails if required without allowing lateral movement.

AUXILIARY TRAIN CONTROLLING MEANS.—F. J. MCAVOY, 5 Walcott Terrace, Newark, N. J. The invention relates to air brakes, its object is to provide an auxiliary controlling means for passenger and freight trains and arranged to enable the engineer to quickly and accurately control the train, throughout the several cars and practically at the same time and with uniform force. The device may be installed on trains now equipped with New York, Westinghouse, or other types of brake systems.

GRAVITY-CAR CONTROL.—R. C. LYTTLE, 6243 So. Keating Ave., Chicago, Ill. An object of the invention is to provide a gravity-car control which is adapted to automatically slow up a car, such as a freight car, as the latter passes thereover, the braking force applied to the car being proportional to the weight of the car, and the force being applied simultaneously to all the wheels which pass thereover.

RAILWAY-RAIL FASTENER.—A. D. PRESTON, 25 Walter St., Claremont, West Australia, Australia. Among the objects of this invention is to provide a tie plate, clamp and spike which cooperate to securely fasten a rail in place, and to brace the rail against lateral and vertical strains. A further object is to provide a fastener which will prevent the timbers from being cut into, or in other words will cause the tie to be evenly compressed under the weight of train loads.

RAIL-FASTENING MEANS.—S. B. KULL, c/o Warner, 1050 Bergen St., Brooklyn, N. Y. The invention relates to means for fastening railroad rails to ties, one of the objects is to provide means whereby spikes used in connection with railroad rails are more effectively fastened down, another object is to provide means whereby the rail and the spikes can be assembled in place and fastened in their assembled position with a great saving of time and labor.

CAR BRAKE.—F. C. MCKNIGHT and A. MCKNIGHT, 18 So. 8th St., Sharpsville, Pa. Among the objects of the invention is to provide means operated by hand or power for releasing and reversing the brake shaft of existing brake mechanism in either direction, and to provide in such mechanism undercut teeth or dog clutches on a member fixed to the brake shaft to mesh with similar teeth on a sleeve movable on the brake shaft which has a foldable operating lever or handle.

CAR UNLOADER.—E. O. TALIAFERRO, 105 Island Ave. Ext., McKees Rocks, Pa. The foremost object of the invention is to provide an unloader for removing such material as coal, sand, crushed stone and the like, from a railroad car or other vehicle, and to either discharge the unloaded material at a fixed point, or at various points. A further object is to provide mechanism which operates slowly down the length of the car, and removes such material in a swath of a width equal to that of a standard car.

COUPLING FOR RAILWAY CARS.—M. K. CARR, 638 2d St., Bremerton, Wash. This invention has for its object to provide a device which is of simple and durable construction yet reliable in operation, and which is adapted to effect the automatic and efficient coupling of the cars or other vehicles, and which may be released without necessity of the operator going between the cars or vehicles.

GRAIN-CAR DOOR.—J. E. DRAKE, Blue Rapids, Kan. Among the general objects of the invention is to provide an auxiliary grain-car door to be employed beneath any approved main door, the auxiliary door being adapted to be detachably secured at its ends to the sides of the door frame and provided with an opening controlled by a closure so that the auxiliary door while in position will permit the flow of grain and be bodily removable when sufficient of the material has run from the car.

Pertaining to Recreation

GAME.—H. I. CORY, 315 Jackson Ave., Jersey City, N. J. The invention relates to a game apparatus wherein a large or small number of players may entertain themselves. The apparatus comprises a casing and a rotatable disk, the disk having a plurality of apertures therein, said apertures being arranged in circular and radial groups, the circular groups representing va-

rious suits in accordance with a card game, the apertures in any radial group having the same numerical value.

WHEELED TOY.—B. NEFEDON, 715 Hopkinson Ave., Brooklyn, N. Y. This invention relates to a toy airplane mounted upon wheels and provided with a sail so that the toy will be blown over the ground. A further object is to provide a toy formed in several interfitting sections which may be disassembled permitting the top to be packed in a relatively small space.

GAME APPARATUS—C. F. Doerr, 260 W. Broadway, New York, N. Y. The invention aims to produce a single gameboard and set of playing pieces with which a plurality of strips may be associated, in which said strips bear indicating indicia simulating various well known games such as baseball, golf, tennis and the like, the device may be readily changed for the playing of the various games.

TOY WAGON—W. H. LAZEAR, 403 Craigie Hall, Cambridge, Mass. The object of the invention is to provide a carriage the axle of which will impart a rocking motion to its body. A further object is to accomplish this rocking motion without alternatingly increasing and decreasing the power necessary to move the carriage by the introduction of a balancing weight, the result being a constant, even pull or push.

GAME APPARATUS.—K. O. STROMEE, 405 H St., San Bernardino, Calif. An object of this invention is to provide a game apparatus consisting of blocks or rectangular game pieces having numerals thereon arranged in such manner that a game or games may be played which exercises the mental faculties in problems of arithmetic and which constitutes a game of skill as well as of chance. The game may be played by children or adults and lends itself to a wide variety play to exercise the player's ingenuity.

TOY.—E. F. Fox, Williamsport, Md. This invention relates to toys of the automatic or self-propelled type. An object is to provide a miniature or toy airplane having means to cause the same to take flight and move about in the air in a manner closely simulating the movements of a full-sized plane of the conventional construction.

Pertaining to Vehicles

SPRING WHEEL FOR VEHICLES.—H. J. M. PENY, 6 Rue de Milan, Paris, France. The invention more particularly relates to a spring or elastic wheel for motor cars, and is characterized by a combination of rubber members which cooperate simultaneously to the wheel an elasticity which can be compared with the one obtained by the use of pneumatic tires, without the disadvantages of the latter.

SHOCK ABSORBER.—L. M. NEAL, 949 First St., Louisville, Ky. The invention relates generally to shock absorbers and more particularly to the type adaptable to transversely disposed body springs and therefore especially applicable to Ford automobiles, the object being to provide a simple and durable arrangement which will promote a sightly appearance and may be quickly installed by a simple addition to the spring parts already in use.

FENDER.—F. BUSH, Pressmen's Home, Tenn. An object of the invention is to provide a fender which is normally concealed within the bumper bar of an automobile, and which may be quickly moved to operative position to prevent injury to pedestrians or live stock which may inadvertently get in the path of the machine. A further object is to provide a spring operated device, and pedal controlled means for operating the same from the driver's seat.

RIM MOUNTING.—W. W. VOSBURGH, 93 Fourth St., Troy, N. Y. The invention provides a rim mounting which shall primarily permit of the association of a rim with a felly of a wheel in such a manner that all play as well as uneven strain upon the parts will be avoided. A further object is the provision of a device by means of which a single manipulation of the parts will serve to achieve the result, so that it will not be necessary to handle numerous parts, resulting in the soiling of hands and clothes.

SEAT SUPPORT.—F. A. SCHNUPP, Mechanicsburg, Pa. The purpose of this invention is to provide a simple and efficient means for removably supporting the rear seat in the body of a motor vehicle in such a manner that the seat may be easily positioned, or removed in an expeditious manner, for converting the automobile body into a van or truck.

SHOCK ABSORBER.—B. KERR, 371 Cromwell St., Sarnia, Ontario, Canada. This invention relates to shock absorbers or fluid cushions, adapted primarily for use in connection with automobiles or other vehicles, in order to reduce the play between the body and running gear, especially the rear axle and housing of an automobile, whereby to allow the springs to be compressed with a very small amount of resistance and to absorb shocks due to recoil action in passing over uneven road surfaces.

OPERATING DEVICE FOR TIRE VALVES.—H. M. HOWELL, Monroe, La. The object of the invention is to provide an operating device for tire valves which may be conveniently and quickly associated with the barrel of the valve and which when so associated automatically engages, depresses and maintains depressed the stem of the valve proper thereby unseating the valve and permitting the air to escape, without requiring further attention, thus permitting deflation of the tube and packing by one person.

SHOCK ABSORBER.—R. M. GRUSS, Cadillac Hotel, San Francisco, Calif. Among the objects of the invention is to provide a shock absorber adapted to be applied to motor vehicles or the like for use in combination with the spring suspension thereof, for absorbing and equalizing shocks incident to travel of the vehicle over rough roads, and to make the vehicle ride easier.

MOTOR VEHICLE CONTROLLING SWITCH.—H. GOTTESMAN, c/o Munn, Anderson & Munn, Woolworth Bldg., New York, N. Y. The invention relates to locks and alarms for motor vehicles, and more particularly to a device adapted for use in the ignition circuit. Among the objects is to provide a lock of the permutation type, which serves to control the operation of a switch. A further object is to provide an alarm in combination with an electric switch in such a manner that upon an attempt by an unauthorized person to operate the switch the alarm will be sounded.

COMBINED WHEELED AND ENDLESS-TRACK VEHICLE.—E. RIMAILHO, 12 Rue de la Rochefoucault, Paris, France. An object of the invention is to provide a construction of apparatus in an automobile or other vehicle having wheels and endless tracks and capable of drawing directly or carrying a load over any kind of ground, whereby either of the two methods of progression may be brought into use at will, the one being suitable for roads, the other for various kinds of ground to be traversed.

ILLUMINATING ATTACHMENT FOR AUTOMOBILES.—A. H. SELL, 858 So. 13th St., Newark, N. J. The invention particularly relates to an attachment embodying a reflector for throwing the light to the object or area to be illuminated, such as the meter or ornament mounted on a radiator, or to illuminate the license tag by reflecting light from one of the lamps on the automobile, for example, one of the headlights.

DEMOUNTABLE RIM.—J. T. LANDIS and R. E. LANDIS, Bureau of Military and Civic Achievement, Washington, D. C. An object of the invention is to provide a demountable rim of two sections, each section having its tire bead retainer or flange integral therewith. Another object is to provide a separable demountable rim, the point of separation of which is longitudinally or circumferentially of the rim base, with either base portion of the tire resting on its corresponding portion of the rim, the rim is so constructed that it may be readily withdrawn from tires.

WINDSHIELD FOR MOTOR VEHICLES.—E. A. HOWARD, 2321 Ducater Place N. W., Washington, D. C. Among the objects of this invention is to provide an auxiliary wind shield adapted to be associated with the ordinary wind shield sections of a motor vehicle, and to serve as a combined ventilator and storm shield. The auxiliary shield may be easily manipulated and moved to a position so that it will not interfere with the normal disposal of the wind shield sections of the vehicle.

CLAMP LUG FOR TIRE RIMS.—S. B. COLLIER, Orlando, Calif. One of the foremost objects of the invention is to provide a clamp lug for holding the clamping ring of a tire rim in place. Another object is to provide a clamp lug which may be swung out of the ring-engaging position without removing it from the bolt, the lug having a wedge and an eccentric both tending to tighten the clamping ring with each forward or backward impulse of the wheel.

ROAD MAP HOLDER.—J. C. PREWITT, c/o Southern Pacific Milling Co., Santa Margarita, Calif. The invention relates to holders for road maps adapted to be supported in plain view so that the driver of the vehicle may be able to study the map while driving the car. The map may be supported in any convenient place in front of the driver, and the holder is arranged in such manner that it may be secured to the dash board, and the map easily slipped in and out. The inventor has been granted two patents of a similar nature.

SPOTLIGHT AND MOUNT THEREFOR.—F. B. ROBERTS, Freeman, Mo. The primary object of the invention is to provide means for supporting a spotlight, on a vehicle such as an automobile, in such a manner as to render the same adjustable in both a vertical and horizontal plane. A further object is to so construct the device that the movement of adjusting the light will be retarded for the purpose of preventing injury to the electrical connections.

VEHICLE.—F. HERSCHMANN, 11 E. 106th St., New York, N. Y. The object of the invention is to provide a pedal operable vehicle adapted for use by children, the vehicle being attractive in form, easy to operate and calculated for affording amusement and a means for healthy outdoor exercise. The vehicle body is in the form of an animal, or preferably a duck having a bill, and is provided with a sounding device simulating the sound of the animal.

DIFFERENTIAL STEERING MECHANISM FOR TRACTORS.—O. C. HANSEN, Orosi, Calif. This invention relates particularly to a steering mechanism adapted to be applied to the existing parts of a tractor without departing from the original tractor construction and intended to function as a secondary steering mechanism or in conjunction with the existing mechanism to enable turns and other maneuvers to be made in restricted areas.

TIRE-CHAIN HOOK AND TIGHTENER.—R. J. KLEINECK, Oxford Junction, Iowa. The invention relates to a device for tightening tire chains and other chains, its general object is to provide a device for the indicated purpose whereby effective leverage can be exerted for drawing the chain tightly and whereby the parts will be automatically latched after the tightening movement.

SIGNALING DEVICE.—F. A. GOODHUE, 48 Cross St., Winchester, Mass. The invention has for its object the provision of means whereby the signal hand may be promptly returned to its inoperative position within a casing upon being released. A further object is to provide means whereby the spring which returns the signal hand to its inoperative position is at all times enclosed and thereby protected from the elements. A further object is to provide an electric light in connection with the signal which is also controlled by the signaling mechanism.

HEADLIGHT SHIELD.—J. H. PITSCHMAN, 177 Goethe St., San Francisco, Calif. The primary object of the invention is to produce a simple and practical device which may be conveniently installed within conventional headlights in such a manner as to cut out all possible glare annoyance, without sacrificing any of the light rays so far as concerns an adequate illumination of the highway within an area sufficient for all driving requirements.

WHEEL.—J. H. LOCKETT, 408 Raymond Apartment, 1461 Alice St., Oakland, Cal. The principal object of the invention is to introduce shock absorbing or cushioning means between the rim and the hub of a wheel in such a manner as to be covered by the supporting structure. A further object is to provide a plurality of cushioning members cooperating with each other in such manner that each of them will support the load independently, and in case of damage allows of the removal and replacing of one cushioning member while the full load rests on the wheels.

HEADLIGHT.—R. L. RICE, SR., and W. M. JORDAN, JR., Hovey, Miss. This invention relates to headlights for automobiles or similar vehicles, and has for its object to provide means wherein the headlights are controlled by the steering mechanism in such manner that they turn with the steering wheels of the vehicle whereby the road is illuminated even on the sharpest turns. Further objects are to provide means by which the lights may be controlled to remain stationary, or may be removed and used as a spot-light enabling the driver to readily carry out repairs. (See Fig. 6.)

INNER TUBE FOR PNEUMATIC TIRES.—R. NALL, 668 38th St., Oakland, Calif. The invention relates in general to pneumatic tires as used on vehicles or automobiles. The primary object of the invention is to overcome the many disadvantages of the customary inner tube by providing a tube which will be unusually rugged and capable of withstanding abuses, and at the same time require only a moderate air pressure to supply the desired supporting medium. (See Fig. 7.)

ANTIGLARE SHIELD FOR HEADLIGHTS.—H. E. LUX, 149 Southern Parkway, Rochester, N. Y. This invention has for an object to provide a side illumination for automobiles by utilizing rays from the headlights without the necessity of providing special lights at each side of the car. A further object is to provide an attachment for headlights, which incidentally constitutes an antiglare shield, and is adapted to be secured in front of the glass of the head light. (See Fig. 8.)

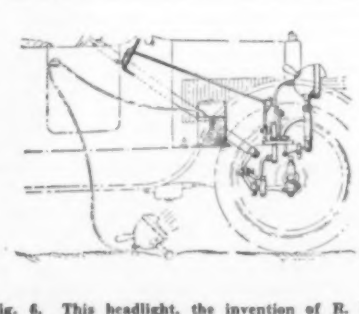


Fig. 6. This headlight, the invention of R. L. Rice, Sr., and W. M. Jordan, Jr., automatically follows the bends in road

Fig. 7. R. Nall is the inventor of this ingenious inner tube

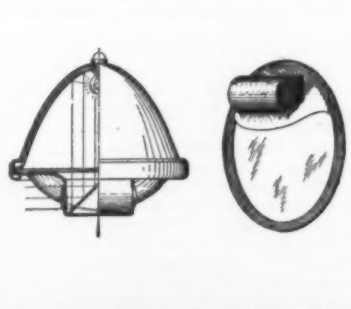


Fig. 8. To combine sidelights and headlight and cut out glare, H. E. Lux has invented this device

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

A Suggestion in Automobile Design

To the Editor of the SCIENTIFIC AMERICAN:

There is a point in the construction of most makes of automobiles which may be the source of many accidents. This point is the front tip of the front spring hanger.

As this front tip is now usually constructed, when, as occasionally occurs, the top spring leaf breaks close to the tip, the under leaves slide forward an inch or two, throwing the car body out of balance on the chassis and also tightly jamming the steering gear. Then the car of course leaves the road, to be more or less smashed, according to the rate of speed and the condition of the roadside.

The broken spring tip, when noticed, is charged up to the effect of the crash instead of its cause, and the newspapers call it a mystery that the driver lost control of the car.

The front spring tips get a great deal of strain, where there is only the thickness of the top leaf and are apt to break sometime. The writer had this happen when he was going slowly enough to stop within thirty feet after leaving the road so that he was not wrecked.

Should not these front hanger tips overhang so that the lower leaves would not thus slide forward and jam the steering gear?

F. P. GRISWOLD.

Meriden, Conn.

Resuscitation: Fact vs. Propaganda

To the Editor of the SCIENTIFIC AMERICAN:

May we have space in which to comment upon the article appearing in one of your issues some time ago, "Making Use of Gas in the Home Safe"? We assume your correspondent, in preparing this article, abstracted a leading article in the current issue of the "American Gas Association Monthly," by Dr. Henderson, to whom reference is made.

As to Dr. Henderson's report itself, we are taking such steps as we feel proper to assure a continuation of the successful use of the pulmotor—the same resuscitation apparatus, as you will recall, which was highly honored by your organization in 1913 in the award to it of the SCIENTIFIC AMERICAN Gold Medal for the most successful resuscitation apparatus developed in three years.

As regards your correspondent's abstraction of Dr. Henderson's report, there are two statements which are distinctly contrary to fact and for which even no authority can be shown in Dr. Henderson's report. It should also be noted that these statements are decidedly discreditable to the pulmotor and contrary to the ideas of the officials of the Consolidated Gas Company of New York, who are still depending upon their pulmotors for resuscitation work.

The quotations referred to follow:

"An investigation has shown that the usual method of using a pulmotor is far from being satisfactory. In some cases actual injury is done by inexperienced handling of the apparatus and the results, at best, are uncertain."

"The use of this apparatus has proved so great an advance over other methods that a number of rescue squads maintained by the gas company are now working in New York City with remarkable success."

Regarding the first of these statements the Consolidated Gas Company of New York have had pulmotors in uninterrupted service since 1912. The pulmotors are still being used. We are in receipt of supply orders on an average of more than one order every two weeks for maintenance of pulmotors for the Consolidated Gas Company, indicating that they are given considerable use.

As an indication of the service being rendered by the pulmotors of the gas company of this city, permit us to quote as follows from the August number of the "Mutual Aid Bulletin," which we understand is published by the Consolidated Gas Company:

"On Thursday, July 6, 1922, at 11:29 A. M., the Consolidated Gas Company's emergency despatcher received a report from the police department to send all available pulmotors to a fire which had occurred in a train on the lower level of the Lexington Avenue Subway at Fifty-ninth Street.

"Four pulmotors were immediately sent to the scene and upon our arrival found a score of men and women partially asphyxiated from poisonous gases other than illuminating gas.

"Messrs. DeVorack, Wheeler, Hahn and Duane of the Twenty-first Street and Sixty-sixth Street emergency stations, rendered very heroic work in reviving a number of the victims, and were very highly praised by Dr. H. M. Archer, chief surgeon of the fire department with whom they worked in conjunction.

"In a statement signed by Dr. Archer he stated that 'It was the Consolidated Gas Company's pulmotors which probably saved the lives of several.'

"In the case of Harry Yonojsky of 112 East 103rd Street, one of the victims, the crew worked on him for 40 minutes. Dr. Archer stating on the company's pulmotor authorization blank, 'pulmotor saved this man's life. He was very near death and we called a priest. Sent to the Reception Hospital after we had restored him to consciousness.'"

Please note that the date of this incident was July 6, a time when Dr. Henderson's inhalators were available for use through the Consolidated Gas Company. Had that organization thought so highly of these inhalators as would be indicated by your article, would it not be reasonable to suppose that they would have been put into service on this occasion instead of the pulmotors?

May we also briefly summarize from an article appearing in the house organ of the Consolidated Gas Company known as "Gas Logic," issue of April, 1922, as follows:

"This year marks the tenth anniversary of the Consolidated Gas Company's introduction of the pulmotor for practical use in this city. Its adoption considerably later by private institutions and by several of the city departments has made it so familiar as a means for the resuscitation of persons who have been overcome by poisonous fumes of all kinds and in cases of 'near drownings' that the casual use of a pulmotor and its frequent mention in the news columns of newspapers elicits little, if any, attention. * * *

"These requests for the use of the Gas Company's pulmotors are not by any means confined to cases of persons overcome by artificial or illuminating gas. In many instances the pulmotors are used for the resuscitation of adults or children who through accident have narrowly escaped drowning. In many other cases persons have been overcome by smoke or the fumes of chemicals that have been formed or liberated by fire. A man and his wife, both past 75 years of age, were both revived after pulmotors had been used about an hour upon them. The entire number of calls for pulmotors since November 1, 1912, was 2801; not used in 1253 cases, successfully used in 1112, unsuccessfully used in 436 instances."

With the above facts before you, is there any possible way of justifying the statement that the usual method of using the pulmotor is far from being satisfactory?

Incidentally, may we call to your attention that "Pulmotor" is a registered trade name protected by U. S. copyright, and the initial letter should always, therefore, be capitalized. This is not to be construed as a criticism of your correspondent, however, as Dr. Henderson made such improper use of the word in his report.

As to the statement that "In some cases actual injury is done by inexperienced handling of the apparatus," you will surely appreciate that such a defamatory assertion regarding any apparatus and particularly as applying to a life-saving device with such a remarkable record and reputation as the pulmotor cannot and must not be made unless unquestioned proof is submitted. No such proof has been given in the report, nor has it ever been given nor can it be given, since no case is on record which can give the slightest indication of harmful results from pulmotor operation.

In regard to the last of the objectionable statements, viz., "The use of this apparatus (Dr. Henderson's specially invented inhalator, known commercially as the H. H. Inhalator) has proved so great an advance over other methods that a number of rescue squads maintained by the gas company are now working in New York City with remarkable success"; this statement is entirely contrary to the facts.

The H. H. Inhalators so highly recommended by Dr. Henderson were installed for test purposes only by courtesy of the Consolidated Gas Company. The Gas Company has never owned any of them. They have not been used by the Gas Company in any case of respiratory failure, but only after spontaneous breathing had been established by the pulmotor which always accompanied the H. H. Inhalator on such emergency wagons as carried the inhalator. Officials of the Gas Company have informed us definitely that the H. H. Inhalators are not now in use and that the pulmotors are used exclusively as they have been for ten years.

Many experienced physicians who have devoted a great deal of their time to industrial work have taken issue with Dr. Henderson, who is openly commercializing his patented inhalator, in respect to the advisability of using carbon dioxide at all in resuscitation work.

In this connection, I beg to quote as follows from a recent report issued by the Carnegie Steel Company. In making reference to Dr. Henderson's recommendations to use a small percentage of carbon dioxide with oxygen for inhalation purposes, the report reads:

"However, it must be remembered that these experiments were performed on cases where the saturation of the blood with the CO_2 was not over 40 or 50 per cent, and while there is no doubt about the CO_2 increasing the depth and number of respirations, yet it must also be remembered that in severe cases of gassing the percentage of saturation is much greater and that the heart is greatly weakened, so that with this sudden excessive stimulus it may fail. I would not, therefore, recommend this form of treatment, except in expert hands, nor do I believe that in its present state of development it should be used in severe cases of gassing.

"During the last few years, quite a controversy has arisen over the relative merits of the manual and mechanical means of artificial respiration, but both have their advantages and disadvantages. I prefer the mechanical method, using the pulmotor. In over 100 very severe cases, this apparatus was used and excellent results obtained, with no noticeable after effects."

In view of the facts presented above, which may be confirmed in any manner desired by you—although, of course, not through Dr. Henderson since the doctor has amply shown that he is not a disinterested party on the subject of resuscitation—we feel very strongly that a statement should be made in the next issue of the SCIENTIFIC AMERICAN pointing out that the pulmotor is being used successfully, that the statement that actual injury is caused in some cases by its use is not borne out by experience and that the Consolidated Gas Company of New York is continuing to use the pulmotor exclusively with the very best of success. We do not request this so much because we are manufacturers of the pulmotor, but more especially because it is of vital importance that the remarkable life-saving now conducted by the local gas company and hundreds of others with their pulmotors should be extended everywhere possible for the conservation of human life in general. Realizing as we do that your editorial staff desires entire accuracy in its columns, we feel confident you will make suitable adjustments in this matter.

AMERICAN ATMOS CORPORATION.

New York. F. F. MORRIS.

Container Cars Fifty Years Ago

To the Editor of the SCIENTIFIC AMERICAN:

In a recent number your description of the Container System of transportation from London to Belfast, brings to mind that the same system was in use half a century ago on the Fall River Line, for carrying fast express between New York and Boston. Your illustration shows four containers stayed fore-and-aft on a flat car; the Fall River Line had a car arranged to carry containers its full length. One morning the "steam boat train" tried to pass a freight train standing on the main line at Randolph, with the usual results; the containers were broken open and the contents scattered over the landscape.

C. H. PEABODY.

University Club, Washington, D. C.

Solving the Water Supply Problem at Panama

To the Editor of the SCIENTIFIC AMERICAN:

Pumping fresh water 770 cubic feet per second, 85 feet high, at 71.25 per cent efficiency of plant, will require 10,000 indicated engine horsepower. An engine condensing will use, indicating auxiliaries, not more than one-half as much boiler horsepower as the engine indicated, or 5000 boiler horsepower. Compare such a plant with any of the great power plants of New York and other large cities, and it will be seen that the power required is comparatively small. The cheapest fuel would no doubt be coal, which could be shipped from the Alaska coal fields, or from other sources of supply on both the South American and the North American continents. The amount of coal required per year, with such a power plant running continuously, evaporating 10 pounds of water per pound of coal at 212 degrees Fahrenheit, would be 75,555 short tons. Assume that coal delivered to the canal by water will cost $5 per ton, then the annual coal cost would be $377,775.

A pumping plant for this purpose, using direct-connected steam pumping units, should not cost more than $100 per indicated horsepower, or $1,000,000 total investment.

To sum the whole problem up, the annual cost for pumping all the water used as for the year 1920 would be:

Fuel	$377,775
Ten per cent interest and depreciation	100,000
Operation	122,225
	$600,000

But the total water for power and lockage required in 1920 must have been nearly 2500 cubic feet per second; and if the shipping should increase to the equivalent of the Sault Ste. Marie Canal, it might be 6000 cubic feet per second. If the Chagres River furnished 2500 cubic feet per second in 1920, it may be assumed it will do it again. This would have 3500 cubic feet per second for which power would be required, or $\frac{3500}{770} = 4.5$ times the amount as calculated for the locking in 1920, or $2,700,000 per year. The revenue from the canal for one year is now about $11,000,000; this would be increased to 4.5 times, or $49,500,000 at the cost for pumping would be approximately 5½ per cent of the revenue.

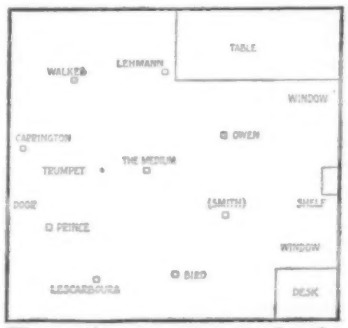
PANAMAN.

Our First Test Seances

(*Continued from page 14*)

manifestation that was about to occur. Mr. Lescarboura reports that this synchronism was perfect.

In the meantime, my button was shining forth unwatched; I was too busy to pay it much attention. The line of sight for these buttons was carefully placed, sufficiently far in front of the medium to make it certain that he could not see them if he stayed in his chair. We figured that if he found the lights we should know that he had been up and moving about. At 9:18, just 53 minutes after we sat down, he did find them. That is to say, at this moment he asked about them; eclipses had been fast and furious for some time, suggesting that he had discovered them earlier, and been trying to make out what they were. He asked whether they were psychic lights, giving us a lovely mental picture of a fake seance, at which one of the spectators might produce what the "medium" would take for genuine phenomena, to his everlasting and terrified bewilderment.



The seating arrangements for the seance of Monday, May 21

We were ready for the question. We explained that the lights were range lights to locate the far wall; at the Monday seance I had had so much difficulty trying to locate phenomena that we had decided to introduce this definite mark of the room's extent, as a possible aid in this direction. It was pointed out that nobody "need" see the lights save me—we did not tell him outright that nobody could see them if he sat quiet; and that accordingly nobody need be distracted by them. Considerable phenomena had been produced, barring the plea that they distracted the spirits; so the explanation was accepted, how willingly I do not know.

It had been found that, even with a poverty of phenomena, we could not remember the sequence of the seance sufficiently well. We therefore called in the aid of the Dictograph Products Company, and they supplied us one of their machines. On Tuesday we put the transmitter on the shelf with the electric fan; on Thursday, on top of the lower sash of one of the windows, quite behind the black screen and out of sight. The wires ran out of the window and to the adjoining room, where a stenographer was posted. Tests made it plain that he would miss some of the phenomena; so he was instructed to pay careful attention to my voice, which carries well and is easily identifiable over the wire. I commented upon the phenomena in appropriate fashion as they occurred, and the resulting transcript, pieced out from the memory of the sitters, gives a remarkable running account of the two seances at which this apparatus was employed. We even have such details as the songs sung and the times at which they were rendered—on Tuesday 21 titles were used, four of them being repeated. It will now be plain how we know the moment at which the medium announced his discovery of the range lights.

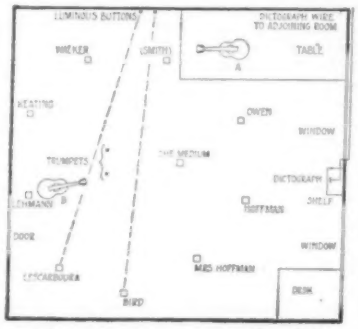
Tuesday's seance was marked by psychic lights, to the number of half a dozen or so. Here we came closer to the best standard than in any other phenomenon. But Messrs. Keating, Lescarboura and Lehmann, our electrical authorities, thought they could have been duplicated by draping an electric torch with vari-colored papers. In traveling range they fell short of proving their authenticity; if secured to anything as long as the dark trumpet, they could easily have been manipulated from the circle, and in most cases actually from the medium's chair. One of them illuminated an object, apparently part of the light, which was variously compared to a melon and to the medium's bald head; it might equally have been the large end of the trumpet, carrying the light. The lights were by no means sufficiently impressive to stand independently of the other phenomena.

The sitters and the equipment for the final sitting of the 24th

At 10:25 there ensued a little incident which for a moment looked serious. It was the desire of the SCIENTIFIC AMERICAN to employ no rough tactics whatever, such as putting on lights, seizing trumpets, etc.; we believed that the true character of the phenomena, whether genuine or fraudulent, could be decided without such tactics. I can pledge that this attitude will mark all our seances. Mr. Keating was not aware of this, however, and either seized or tripped, or both, a "spirit" which was touching him with the trumpet. As a result of this the trumpet was swung, apparently without expectation or intent on the part of the manipulator, and struck Mr. Walker rather harder than was in order for a well-conducted seance. Mr. Walker's first thought was of his glasses, and he seized the trumpet. A gentle tug failing to free it, Bert's voice shrieked "Don't do that"; a violent tug was given; and the trumpet fell in sections to the floor.

Mr. Walker, in his excitement, forgot that he had really seized the trumpet and insisted that he had only warded it off. Both the medium and his friend were equally positive in asserting that it had been seized and held. Granting that they were right, it would be interesting to have them explain, without incriminating themselves, how they knew it; Bert did not give it away, unless his exclamation quoted above were a code message. Mr. Walker's explanation and apology were finally accepted, and the sitting went on.

Thirteen minutes later, another interesting incident was had. At some indeterminate time before this, the trumpet had been doing stunts in my vicinity. When it ceased these, I had a pretty good idea where it was, and that I could reach it with my feet. With no particular idea in mind, I tried this, and, as I supposed, succeeded. I certainly made no noise. At 10:38 Bert's voice came out of the air high in front of me, and had a long dialogue with me. First of all, he reproved me for sticking my feet out. I didn't have them out, and said so. He granted this, and explained that he meant before, when I had been "trying to trip a spirit." He laughed at me for not knowing that I couldn't do this. My explanation that I had not been trying to trip a spirit was at first rejected as false, and finally, I believe, accepted by Bert against his better judgment. I wondered whether what I had taken for the trumpet were the medium's foot.



Seats and apparatus for the sitting of Tuesday, May 22. A and B are the initial and final positions of the guitar, respectively

Bert and I then discussed at length the conditions. There was too much furniture in the room to suit Bert, and of the eleven sitters only six were really advantageous to the psychic power. He wouldn't specify, even when urged to do so, but he referred to Dr. Prince as a Doubting Thomas; this was presumably because of the incident of the evening before. Bert objected mildly to the presence of the books. He told me I was the best sitter there, and I tried to make it appear that I appreciated the compliment. Finally he stated that they were about through for tonight, requested that a proposed sitting for Wednesday be deferred until Thursday, and promised us some perfectly gorgeous results on that occasion.

At Thursday's session we had a definite problem to meet. We were assured that the occurrence of the phenomena coincided with the passage of an opaque object about the room. If in this connection we could be assured that the medium did not leave his chair, we should have proved that the phenomena were not due to his active intervention, unless he were bringing into the room something which could be found by searching him. If, on the other hand, we could prove that he did leave the chair at these times, it would seem fairly out of the question for him to hope to establish his phenomena as genuinely psychic.

We secured a piece of thin fiber board, two feet by one, with ten arched-spring contacts on one side. These were sufficiently stiff so that, if placed on the floor beneath a chair, the weight of the chair alone would not bring any of them together; but the weight of a person sitting in the chair would surely close at least one of them. They were wired up in parallel, and the entire unit was in series with a battery and a lamp in the next room. With the board placed beneath a chair and properly connected, the remote lamp would burn so long as the chair was occupied, and would go out when the occupant arose. We tested it out thoroughly in the position in which it was aimed to use it, and found that I (weight, 125 pounds) could operate it infallibly. The medium weighs considerably more than this.

The detection mat was placed under the large rug that covers the floor of the library, with several small mats surrounding it there, to prevent its presence from making too marked a jumping-off place on the floor. The wire was carried under the rug and out the window, and an observer sat at the lamp in the adjoining room with the dictograph operator. Her sole function was to announce when the lamp went out, and, by means of a stop-watch, the period during which it remained out. These announcements were incorporated by the stenographer with his dictograph account.

We were faced with one difficulty, which we finally turned to an advantage. We must be assured that the chair was not moved about. We built up, of lathing, a cage on the floor that fitted snugly about the four legs of the chair. We tacked this to the carpet, anchored it further with adhesive tape, and made it solid at the corners. It was not at all immovable; one could have hitched the chair and carried it along. But we impressed upon the medium that we were anxious to be able to say, at the conclusion of the sitting, that none of the chairs had been moved. Those of the outer circle we had tied together securely with twine; but we pointed out that we could not run twine across the circle to his chair, for fear of tripping the "psychic operators" or otherwise discommoding them. So we had adopted this device. It would not, to be sure, prevent him from moving his chair if he were bent on moving it, we pointed out; but it would make it possible, and easy, for him to occupy it for two hours without moving it. We had hoped that the insistence upon this perfectly absurd test might distract his attention from the real ones which we were using. Such distraction was a bit necessary, because one could sense the additional springiness of the floor under his chair—at least one could when one knew that there was something there.

As another item in this distraction (we were using the magician's stuff, it will be realized), we had the medium and his friend call at our office Wednesday afternoon for the purpose of discussing controls. We suggested several things that we had no intent of doing, to get their reactions. When we asked if there would be any objection to talcum powder on the floor, we were told no, but two points were made: first, the spirits would perhaps leave a trail in the talcum which might be mistaken for the trail of a human; second, we would have an awful time getting the rug clean again, and perhaps we would better realize this and put the talcum in pans, here and there about the floor. We were deeply touched by this solicitude.

It had been the medium's practice, in sitting at home, to employ, quite freely, luminous bands about the wrists of the sitters. We were going to follow this plan, and the medium knew it. Nothing was said to us about any departure from the procedure which one would suppose these bands to imply. We supplied bands of adhesive tape, with one or two luminous buttons pasted on each, and these were very effective in the darkness of the seance room. But when we got nicely settled in the dark, the medium suggested that we hide our wrists, and display them only on call, when phenomena had come and it was in order to account for all the sitters. As a matter of fact, this turned out to be a necessary step, because the presence of all those headlights was quite distracting; and with them visible, every scratch or wriggle by one of the sitters produced a shooting-star effect that was destructive to the morale of the whole circle. Yet under this procedure, the phenomenon is gone by the time wrists are called for and displayed. So this very much vaunted bit of dark-seance technique will not play any further part in our plans; and we shall attach no further value to seance reports where it is used as a control. In our own present case, however, it helped greatly in directing the medium's attention away from the things we were really banking on to check up on the phenomena. I think it will be agreed that this is a proper and very

(*Continued on page 64*)

Science Notes

Big Yale Telescope for South Africa?—It is possible that a powerful telescope will be placed somewhere in South Africa to view some stars which cannot be well studied from the northern hemisphere.

The British Museum Has No Place for Films.—Although the British Museum has over fifty miles of shelving for books they have no space for the safeguarding of historic films like those of the funeral of Queen Victoria. The War Office has preserved films of the British Army during the war.

The Metric System.—The metric system is proceeding slowly as regards its adoption in English-speaking countries. One suggestion which was made at a luncheon given in New York on May 5 by the Metric Association was that the conduct of international trade is at present hampered and confused by the circumstances that the content of the British gallon is greater than that of the American gallon. The recommendation was made that both governments should abandon their standards and adopt in their place the liter as the common unit of capacity.

Curious London Trades.—The London Blue Book is a ponderous tome, but contains some curious information. London has a solitary fisherwoman, who lives in a suburb at Wandsworth; it has one woman blacksmith, who works in Shoreditch; and there is one woman bricklayer, who resides at Deptford. There are two London women who are gasfitters' laborers. While the county of London has but one fisherwoman, the city of London (proper) has but one fisherman. Among the queer trades are: "Hecklers," "jacquard punchers," "plunkers," "teasers," "slashers," "scratch-brushers."

Petroleum Among the Ancients.—The oil industry had its birth in the United States about 1858, when crude oil was analyzed and a well was drilled at Titusville, Pa. But our Indians, and the races before them, knew crude oil. Thousands of years before Christ, Babylonian and Chaldean masons used it in semi-liquid form for cementing the bricks of their towering walls, and it was used in building the Pyramids. Herodotus mentions a well from which three substances, asphalt, salt and oil, were pumped. Oil from natural springs in Sicily was used in lamps in the temple of Jupiter at Rome, and the wealthy illuminated their homes with it. The ancient Chinese and the Persians used it for light and heat, and it enters into the preservatives of the Egyptian embalmers.

Cultivating Perfumes.—A process, the invention of M. Daniel, professor of botany at Rennes, by which the perfume of flowers is greatly increased has been explained before the Académie des Sciences in Paris. By taking two plants of the same species and grafting one on the other—notably a wormwood on a chrysanthemum—he found not only that the grafted wormwood developed remarkably, but its flowers gave forth a perfume much more powerful than that of the original plant. Moreover, the chrysanthemum had given to the wormwood flower something of its own perfume. The professor collected the seeds of the grafted wormwood and the following year obtained from them some fine plants. They had this peculiar feature—that while the flowers of some of the plants emitted a perfume similar to those of the original graft, others were absolutely without odor.

A Gas Celebration.—The Consolidated Gas Company of New York City recently celebrated their centenary. The first plant of the old company was built at Hester and Rhynder (now Center) Street, and one mile of three-inch main was laid in Broadway. The first gas street lamp lighted was at Wall Street and Broadway, and a crowd, keeping at a respectable distance because of the fancied danger of an explosion, witnessed the ceremony. The house of Samuel Leggett, president of the company, at 7 Cherry Street, was the first house in New York City to have gas illumination. The first gas container of the old company had 18,000 cubic feet of gas and the superintendent was criticised for extravagance for erecting one of such large capacity. Today in Astoria, L. I., the Consolidated Gas Company has a series of gas holders, two of which, the largest in the world, have a capacity of 15,000,000 cubic feet each. In 1826 the cost of gas to the consumer was $10 a thousand cubic feet. It had fallen to $7 by 1834, but jumped back to $8 later because of the increased cost of materials.

Science Notes

Forty Million Marks for an Elephant and a Hippopotamus.—Hanover has been obliged to sell part of the Zoo. A French animal show paid 40,000,000 marks for the two animals named above.

How France Solved Daylight Saving.—Summer time received a set-back when the French Cabinet decided not to interfere with Standard time, but that everything should start half an hour earlier. Noon trains leave at 11:30, the theaters raise their curtains at 8 instead of 8:30, and so on.

Spiritualist Sunday Schools Attacked.—Spiritualistic Sunday Schools are making a certain amount of progress in England. About 13,000 attend such services. Efforts are being made to influence some of them to become mediums. This has resulted in powerful attacks backed by well known persons.

Greece Adopts the Gregorian Calendar.—Beginning with March the Gregorian calendar was adopted for civil purposes in Greece. As Russia has apparently adopted the same course the old, or Julian style, has become practically obsolete. The Greek Church is not at present adopting the reform, the reason being the expectation of the speedy adoption of other calendar changes in the west, for which it prefers to wait.

Will Map Europe's Sky.—A plan to map the entire sky of Europe is being carried out under the direction of the National Weather Bureau, which already has mapped the sky of France. Weather observers and amateur photographers of the Continent will be asked to assist. The photographers will be asked to make daily exposures over a period of a week or two. The photographs will be sent to the National Weather Bureau, where the causes of the weather conditions at the time will be retraced from them.

Hockey in Ancient Greece.—An ancient Greek sculptured relief recently discovered in Athens, according to the London *Times*, gives evidence that the Greeks played ball games other than with the hand. The relief represents six naked youths taking part in a game bearing every resemblance to modern hockey. The curved stick used may possibly supply an explanation of the singular curved object carved in relief on some of the votive offerings found at Sparta. These have been called "sickles." It is difficult to say why this implement should have been dedicated to Artemis, but the word "sickle" may have been the current slang for a boy's hockey-stick.

Radio Messages in Thunderstorms.—The Weather Bureau, although without facilities of its own for conducting investigations in this field, has cooperated in various ways with other agencies also interested in conditions affecting wireless telephony. As a result of work done by Nebraska Wesleyan University based on thunderstorm reports furnished by the Weather Bureau the investigators reached the conclusion that there is no relation between barometric pressure and audibility, and that conditions at the sending station do not influence the audibility at a distant receiving station. High static frequency, high static audibility and a nearby thunderstorm area, however, tend to reduce the audibility at the receiving station.

Jungle Instincts of Caged Animals.—Wild animals in captivity live at night an imaginative life entirely different from their dull day hours when the curious file by in front of their cages, according to Mr. R. T. Pocock, superintendent of the Zoological Gardens of London, who is about to retire after many years of service. At night, he says, the inborn habits of the jungle show themselves in striking fashion, and the beasts throw off the sleepy veneer of indifference they seem to adopt when humans stand in front of their enclosures and speculate upon what might happen were the animals suddenly given their liberty. "If you go into the lions' house during the day you are nearly always impressed by the peaceful way in which the animals regard you. But visit them in the darkness and instantly you are aware of the change. As if by magic their instincts to hunt and to kill have returned. Nothing is more weird than to walk past the cage of a lion or a tiger and then turn around. To your astonishment you see that the animal has been stalking you just as if he were still living in natural surroundings. The instant you turn your head he drops flat on the floor of the cage." Mr. Pocock believes that wild animals never make good pets and that man has domesticated every animal worth while.

Electrical Notes

Rubber-Covered Tools.—While there is nothing new in rubber-covered tools, it is only of late that such excellent insulation is available on pliers, screw drivers, and other tools for electrical work. The insulation in this case is soft rubber, which will not harden or lose its insulating properties for a long period of service. One line of soft rubber-insulated tools is guaranteed to be tested for 100,000 volts applied for five minutes, which is obviously a more severe test than the tools are ever likely to receive in the usual run of work.

The Largest Waterwheel Generator Yet Made has been ordered by the Niagara Falls Power Company for its No. 3 power station and is the first of two units of the same size being built in the General Electric shops. Each generator will weigh 700 tons and will be 26 feet high and 35 feet in diameter. Both as to size and capacity they are the largest in the world. They will be driven by 70,000 horsepower hydraulic turbines made by the I. P. Morris Department of William Cramp Sons Shipbuilding and Engine Company of Philadelphia. Each generator will have a rating of 65,000 kilovolt-amperes.

The Longest Submarine Power Cable in the world, according to Japanese claims, has recently been laid and is now transmitting power from Niihama to Shisakajima, Shikouku. The cable is about 13 miles long, and consists of 23 factory lengths, each measuring 3000 feet. The cable is composed of three sector-shaped conductors having a cross-sectional area of 100,000 circular mills each. Each conductor is insulated with impregnated paper, and the three conductors are wrapped with the same material and enclosed in a lead sheath. Around the sheath, continues *Electrical World*, is a jute bedding wrapped with galvanized-iron-wire armor served with jute yarn. The cable contains four copper tapes within the outer belt insulation. These tapes serve as a protection of the power conductors and are also used for two telephone circuits. The finished cable is three inches in diameter and weighs 6.3 tons per 1000 feet. It was tested at a pressure exceeding the working pressure (namely, 11,000 volts) by 50 per cent after the cable was laid.

Cooling Storage Batteries.—At several of the sub-stations of the Southern California Edison Company in the San Joaquin Valley, where the summer temperature is often very high, the storage batteries used for oil-switch tripping and emergency lighting have been installed in the ground to keep them cool. The sub-station buildings have glass sides, and although this is an advantage from the standpoint of lighting and fireproof construction, the temperature in the buildings in the summer is often considerably higher than the outside air. As a result of this condition the storage batteries are installed in sections of concrete pipe placed just below the surface of the ground, where the temperature is considerably lower than in the sub-station buildings. These sections of pipe are placed on end in the ground in holes dug for them. After the necessary conduit for the wiring has been installed, a concrete slab is poured in the bottom of the pipe for the batteries to rest on. A cover made of cast concrete is used. An additional galvanized cover is provided to prevent collection of water in rainy weather.

Cooling Methods for Large Transformers.—Only two methods of cooling large power transformers are being considered today in Europe. In one of these methods, continues *Elektrische Betrieb*, the hot oil from the transformer is pumped through an oil-pipe system, over which a shower of water is directed. Being arranged within a cooling tower, the same water is used over and over again. The method requires one oil pump and one water pump. The second method dispenses with water entirely and directs a powerful blast of air across the oil-pipe system, requiring one oil pump and one air blower. Experiences obtained on the 100,000-volt transmission systems of Germany have shown that the second method, in spite of its higher initial cost, is more economical and reliable in operation, particularly where the water conditions are not perfect as when only impure or carbonated water is available. The heated air, after leaving the oil-pipe system, can be and is being used advantageously to heat the operating rooms of the station or sub-station, whereas with the first mentioned method a special steam-heating plant has to be provided.

Electrical Notes

Electrification of the French Railways, involving of five billion francs during a period of ten years, is the program of the French Government, which has approved the immediate expenditure of 90,000,000 francs on the Paris-Ouest Orleans line and 124,000,000 francs on the Midi line.

Electrical Heating for a "Shrink" Fit.—In order to fasten securely the shaft of a 4000-kilowatt rolling motor into its large rotor casting, a "shrink fit" was decided upon. The necessary shrinkage was calculated to be from 0.5 millimeters to 0.6 millimeters, requiring the heating of the bulky casting to about 200 degrees Centigrade to 220 degrees Centigrade. To accomplish this without undue loss of time and with greatest accuracy, electric heating was resorted to, using alternating current in a few turns of cable around the rotor hub as a short-circuited secondary. A number of calibrated thermocouples, placed at different points on the hub, measured the rising temperature during the process. The job was successfully finished in 16 hours, consuming 50 kilowatts, of which 3½ kilowatts were the copper losses in the cable.

Permanent Magnet Steel.—Extensive research work carried on in the Physikalisch Technische Reichsanstaldt—the Bureau of Standards of Germany—with various steel alloys suitable for permanent magnets resulted in the discovery of an alloy steel with considerably improved magnetic properties. Based upon previous tests on iron-manganese steel with an addition of cobalt, the saturation of the steel has been increased beyond values previously known on chromium and tungsten steel, according to *Electrical World.* A further improvement was achieved by adding 5 per cent of chromium, resulting in a three times higher product of remanence and coercive force. The best results were obtained with an alloy containing 1.1 per cent carbon, 3.5 per cent manganese, 36 per cent cobalt, 4.8 per cent chromium, and 54.6 per cent iron.

Electric Heating of Large Buildings is a subject discussed at length in a recent issue of *The Electrician.* The following interesting figures are cited in connecting the heating requirements and the electrical load necessary to fulfill them. In theaters, which are very economical places to heat, owing to the absence of outside windows, 10 or 15 degrees' rise over the outside temperature is sufficient. Electrically, this means 300 watts per 1000 cubic feet. In domestic work a useful semi-"rule-of-thumb" method is to allow 0.9 watt per cubic foot for a 30-degree rise of temperature per hour, or 0.6 watt per cubic foot for a 20-degree rise. These figures predicate the use of central heating apparatus only. If ordinary fires, either coal or electric, are used in addition, the figures given above may be reduced 50 per cent. It may be mentioned that this data is based on the heating engineer's rule of 18 square feet of heating surface per 1000 cubic feet of space. It may be added that the success or failure of any particular installation largely depends on the positions where the apparatus is installed. In rooms a position under the windows is the best place, but in large halls and churches, places in the roof or half-way up the supporting columns may be used with advantage to counteract down-drafts and to obtain that even heating effect which is so desirable, and this effect is assisted by dividing the heating surface into small units. In this way, too, a great reduction in the electrical load required can also be effected, as witness a case at Edinburgh, wherein a normal heating load of 500 kilowatts are reduced to 64 kilowatts and space was saved by placing the heaters on the supporting columns. Various types of electric heaters may be employed, such as the straight electric heater with resistance wire for generating heat which is imparted directly to the air or, in the form of radiant heat, is directed toward the portion of the premises to be heated, or combination electric-steam radiators, in which electric heaters produce steam in a small radiator unit. The electric system of heating has the great advantages of responsiveness and easy regulation. In an ordinary central heating system control is difficult and can only be effected from one point. In this system each radiator is complete in itself and can be turned on, off or down as required. In heating churches by ordinary hot-water equipment it is necessary to fire up some 48 hours before. With electric heating this preliminary period is reduced to four or five hours.

Mechanical Engineering Notes

Magnetic Separation of Coal From Slag has largely replaced the older method of separation by varying specific gravity wherein water was used. By the dry-magnetic system the varying magnetic properties of the ferric oxide resulting from combustion of the iron pyrites and the combustible matter are used.

Brass Casting.—Not many years ago the chemist was unknown in the brass business, the caster playing "chemist" himself. The master casters mixed their brass alloy with a great deal of mystery but very little exact knowledge. Nowadays the temper of the brass is tested by pyrometers, mercurous nitrate and photo-micrographs, while hydrostatic and other tests expose its weakness.

Keeping Valves Clean.—First put into practice by an automobilist to keep the carbon down, this dodge looks as though it might have a more general application. A simple lock-washer was put on the valve stem, just below the valve; and as the valve moved up and down, this washer was brought into contact with the bearing surface every time the valve rose. The result was a valve always free from carbon.

Centrifugally Cast Iron Pipe requires heat-treatment because the molten iron, being thrown against a rapidly revolving water-cooled metal mold is more or less chilled and, when the pipes are removed from the machine, they are more or less hard and brittle. Pipe made in sand molds do not have to be heat-treated. The furnace used is oil-fired, its heat being controlled by a pyrometer.

Aluminum Solders cannot employ the ordinary soldering metals, excepting magnesium, because they are electro-positive to aluminum and thus act electrolytically in the presence of moisture as positive galvanic poles, accelerating the corrosion of the aluminum. Magnesium, however, disintegrates rapidly in the presence of moisture. Therefore the soldered joints should be protected by paint or varnish. Zinc-tin and zinc-tin-aluminum solders give the best results.

Eyesight in Factories is the subject of an article in the *American Machinist*, wherein is stated that it is almost impossible to find a man with perfect eyesight after the age of 40. An examination of more than 10,000 employes in factories showed that 53 per cent had uncorrected faulty vision. Shop accidents, on this account, occur more frequently in the dark winter months. Painting the factory walls white will not only reduce this trouble but will cut down the light bill.

Zirconium in Heat-Treated Steels.—A writer in *The Iron Age* states that ordinary carbon steels in which a small percentage of zirconium has been incorporated may be made to possess by suitable heat-treatment physical characteristics approaching those of the highest grade, heat-treated alloy steels. Additional experimentation has demonstrated that the properties of a number of the well-known alloy steels may be improved through the use of zirconium. Also that by zirconium treatment it is sometimes possible to use advantageously the ordinary alloying elements in less than normal proportions.

Corrosion Process.—A writer in a recent issue of *General Electric Review* states that much may be learned in a very short time about the corrosion-resisting properties of steel by observing the action of a drop of water upon the polished surface of the metal. Drops of distilled water in equilibrium with the air of the laboratory were placed upon various steel surfaces. In the case of pure iron, corrosion began almost immediately, and at the end of a few minutes the corrosion product could be seen distributing itself, always according to the same pattern. Three distinct zones developed: an outer one, which has been called by us the "immune" zone an inner one, which occupied a large part of the area of the drop; and a "wall" zone, which lay between the outer and the inner zone. The outer zone was perhaps one-half mm. in width, and the wall zone was best described as a line. The iron rust was evenly distributed over the level on the wall zone, and the outer or immune zone was entirely free from deposits of any kind. The length of time elapsing before the first appearance of rust, and the amount of rust present after the drop has evaporated, vary greatly with different steels and form the criterion for judging the corrosion excellence of the particular steel under examination by this simple test.

Civil Engineering Notes

Steel Passenger Cars for India are being made. These will be 68 feet long and will have seating capacity for 100 passengers.

The Proposed Mid-Scotland Ship Canal for the navigation of large ocean steamers between the east and west of Scotland is now under discussion.

The Railways of the World had an aggregate length of 748,000 miles in 1920. Of this trackage North and South America had approximately 50 per cent, Europe 30 per cent, Asia 10 per cent, Africa 4 per cent, and Australia 3 per cent.

Permanent Headboards between the sections of sleeping cars are a new equipment of the Pullman car. The headboards extend out half way from the side of the car to the aisle and give a partial sense of privacy to the occupant of the section.

Two 165-Foot Girders which were shipped from Milwaukee to Eola, Ill., required nine platform cars and were the longest single-piece shipment ever made by rail. Each girder weighed 36 tons and was supported by bolsters at either end, the intervening cars rolling idle.

A Cantilever Roofed Stadium for the 1924 Olympic games is to be constructed at Paris. The roof will overhang a distance of 131 feet, the principle of the cantilever being used permitting support at the rear. This obviates the undesirable obstructions to view in front of the spectators.

An Underground Moving Pathway for Paris is the subject of investigation in that city. Thirteen plans were submitted and five were retained for further experiments. Of these, four work on the principle of parallel bands working at graduated speeds, and the remaining one slows down for each stop.

A Six-Wheel Truck for Freight Cars has been perfected and tried out by a Baltimore steel manufactory. In these trucks each axle is free to assume its true radial position on curves. The center axle acts as the pivot and the other two are hinged to its front and rear sides. Its purpose is to lessen resistance on curves and to cut down wear on both wheels and tracks.

Roller Bearings for Locomotives are being tried out in Sweden, after the failure of ball bearings to stand up under the heavy work. The locomotive department of the Swedish State Railways states, according to *The Engineer*, that the tests with this bearing have not continued sufficiently long to prove whether the arrangement is entirely satisfactory for locomotives.

Ship Salvaging has within the last 20 years been put on a vastly more practicable basis owing to the development of underwater tools such as the oxy-acetylene torch, and underwater pneumatic tools such as hammers, chippers and drills. The telephone is a great help in intelligently and rapidly coordinating the work of the divers. The gasoline engine has made practical the use of small light power units for running air-compressors, centrifugal pumps and dynamos.

The Steam Road Wagon is used quite widely in England owing to the comparative cheapness of coke fuel as compared with gasoline. The road wagon takes the place of the ordinary truck as used for short freight hauls in America. The economic limits of the steam wagon haulage lie between a five-mile minimum and a maximum of 40 miles. They haul over the roads a useful load of about ten tons and get about ten miles per hundred pounds of coke and twenty miles per hundred pounds of Welsh coal.

Merchant Ships of the World.—The need of a work on merchant shipping, corresponding to the well-known annals of Brassey and Jane on the navies of the world has been met by the publication of a volume of 500 pages, entitled "Merchant Ships of the World." Like the books mentioned it is an annual, and both the editor, Frank C. Bowen, and the publishers, Sampson, Low, Marston & Co., are to be congratulated on the thoroughness with which the work has been done. The ships are classified under the countries to which they belong and arranged in alphabetical order, and an illustration is given of the most important ships and of one of each class of ships. The information includes the date, gross tonnage, draft and speed, deadweight, number of holds, size of largest hatches, as well as the length, displacement, details of engine and boiler plant, fuel capacity and the number of passengers carried. The pages measure 9¾ by 12 inches.

Miscellaneous Notes

Water at Auction.—Aden is one of the hottest places on earth. A heavy rainfall recently filled tanks with 3,000,000 gallons of water which was sold at auction.

National Park for Poles.—The Society of Friends of the Tatra Mountains, Poland, is working out a plan for transforming the mountains into a national park on the lines of Yellowstone Park.

Esperanto Congress.—An Esperanto Congress will be held at Nuremburg, August 2 to 8, 1923. Thirty-five countries will send 2500 delegates. A play, Lessing's "Nathan the Wise" will be given in Esperanto.

Ontario Gold Fields.—The gold fields of Ontario have been producing gold for several years, the output of ore having warranted large extension in milling plants. The newly discovered gold fields of Labrador may prove to be a second Klondike.

The Largest Thermometer.—Atlantic City has many novelties to interest visitors. Recently a thermometer 50 feet high has been erected. Promenaders on the boardwalk can read the temperature a mile away. Lights on the board indicate the temperature.

An Expensive Hobby.—A stamp exhibition in London has been insured for nearly $10,000,000. One single collection was insured for $500,000. One advantage of a stamp collection is its extreme portability. All the stamps in the world in albums would only fill a small steamer trunk.

A Large Envelope Order.—It will require 354,388,000 envelopes to inclose the mail of the Government next year, and, as an indication of what these figures mean, the Post Office Department announced today that a contract had been let for 140,000,000 official envelopes for that department alone at a cost of $178,061.

Traffic Troubles of Paris.—There are 80,000 automobiles in the streets of Paris; 1000 cumbersome autobuses; 1200 street cars; 400,000 bicycles, considered the worst pest of all; 19,000 motorcycles, and 30,000 horse drawn vehicles. Everyone who has been in Paris knows that it is as much as one's life is worth to cross any of the principal thoroughfares. Traffic regulation is poor and the laws favor the drivers. There is practically no speed limit and the drivers are very reckless, caring nothing for pedestrians.

Shortening Our Flag.—A reduction of twelve and one-tenth per cent in the length of our national flag has been decided on by the Fine Arts Commission as being the most artistic proportion. Flags of all countries are made up according to well-established mathematical rules and there should be no sentiment about changing an elongated flag to one of better proportions. In consultation with a committee of Government officials appointed for the standardization of the flag, the commission decided on a ratio of 1.67 to 1 instead of the present 1.90 to 1. The decision was reached through tests of various sized flags flown from the Arlington Amphitheater flagpole.

English Banknote Paper.—Paper for English banknotes is made at a paper mill in Laverstoke, near Windsor, where paper for Bank of England notes has been produced since 1724. No visitors are ever allowed except when there is a Royal visit, as occurred lately. The King, Queen and other members of the party were shown through the plant and the many secrets of manufacture were explained to them. The mill was started by a French Huguenot of Poitiers named Portal, who established himself at Laverstoke in 1719. Before Henri Portal undertook the manufacture of the paper, banknotes contained no water-mark, but he introduced a water-mark consisting of a looped border running round the outside of the note and on the left-hand side a somewhat intricate scroll. At first the banknote paper, enclosed "in elm chests with locks and bound with iron," was conveyed by road to Newbury and thence by barge to London, but in 1731 Henry Portal, as he had now become, conveyed it in his own wagon to London. The family monopoly which has existed for 199 years was not held without a struggle in the early days, for the records of the firm in 1737 show that: There was an opposition at this time by One Judd at Yewell paper-mill by which means ye Price was lowered 18 p. Ream, and the duty. Felting and carrg to London all struck off & to be pd and done by ye Maker.

Our First Test Seances

(Continued from page 56)

desirable thing, regardless of whether he be believed genuine or fraudulent, or whether no opinion at all be held as to his status.

The arrangement of all the chairs was necessarily fixed before the medium's arrival; he first saw the room after it had been completely dressed up in twine and wooden strips. He entered the room with a demand on his lips for a complete rearrangement of the position and orientation of the chairs, on the ground that the psychic currents would be benefited thereby. We pointed out how much work would have to be undone, and promised such a change, to be made to his dictation, the next time we sat. He let the matter drop there, which I thought indicated lack of confidence in the argument he had been advancing.

We came near total disruption right at the start. Mr. Orson Munn was in attendance, with a young lady friend. She had not been told just what might happen; and when, shortly after the darkness descended, the spirits selected her for the first touch, she gave forth a shriek that might have been heard blocks away. The medium was very much shaken up by this, but the young lady was quieted and the seance went on.

We had a sitting richer in phenomena than Monday's, but poorer than Tuesday's. Again the medium displayed too much knowledge of what was going on. The trumpet crashed to the floor between Houdini and Mr. Hopkins, and they were uncertain whether to recover it or to let it alone. Without their having given expression to this bewilderment, the medium stated that they were excited and leaning over the trumpet to pick it up, and warned them not to do so. The accusation was in accord with the facts.

Under hypothesis of fraud, little was done that would have called the medium out of his seat. When anything of this character did occur, however, the record showed, without exception, that he was out of it. In all he left it fifteen times, for periods as long as 15 seconds at a time. There can of course be no valid reason for this; and, since he was not in trance, not even a valid excuse. The parallelism between the absences of the medium from his chair, and the phenomena, is displayed elsewhere. It should be emphasized that all his absences from the chair are listed in the table on page 14.

During the evening the medium discovered and questioned the softness of the floor under his chair. The stenographer missed this incident. It was apparently between 9:45 and 10 o'clock, after the preliminary exploration of the circle with a trumpet from the medium's chair had been completed, and the phenomena involving his movement had begun; and also after he stopped his free circulation at 9.45. If one might hazard a guess as to what happened, it would be based upon the fact that the medium's movements were on this evening audible for the first time. This would argue that he is accustomed to shuffling noiselessly about a flat floor, but that one with a little hill under his chair would make him a trifle awkward, and would finally obtrude itself upon his consciousness. After nine comings and goings in nine minutes, he would have sensed the presence of the obstruction, and explored it thoroughly by hand, to assure himself that it was there. Then he would have slowed down materially the tempo of the seance; and that this slowing down had occurred all the sitters realized, even before the sitting broke up and we had time to cast an eye at the records in the next room.

For one more incident of this final seance I must find space, if it involves lifting a column of advertising to make room for it! On Tuesday a whispering voice had presented itself to me, quite close, attempting to articulate a word of two syllables. I and my neighbors at first judged this to be a name. We all strained our ears to catch it, and it was repeated twenty times at least. I encouraged this to go on until I had fully satisfied myself that it was in fact wholly inarticulate, and that anything which it might be understood to have said would have been wholly due to the listener's imagination. Then I encouraged it to stop, and it stopped.

One of the known tricks of questionable mediums is to give such inarticulate sounds, hoping that the sitter will identify them through such active imagination and active desire for the presence of some dead friend as he may have. When it works, it usually "goes big"; the sitter feeds out all sorts of information about the departed one, and promptly gets it back from the voices. I determined to learn, if this whisper was re-

peated on Thursday, whether it would do this.

That the spirits had picked me out of the crowd was plain from the beginning of Thursday's sitting. I got ten touches to every one by anybody else. Finally, sure enough, the same hoarse whisper came to me. I had, on Tuesday, suggested that it was trying to pronounce my name. Over the interval it had adopted this suggestion and made it its own; for now it said "Hello, Malcolm," as plainly as human being could possibly whisper these words. The following dialogue is not necessarily an exact transcript of what ensued, but it is sufficiently so to stand as a faithful account of the incident, in spirit if not in every letter.

Bird: Yes, this is Malcolm. Who are you?

Voice: Wa-wa (I adopt this purely arbitrary symbol for a whispered murmur that was absolutely without articulate form).

Bird: I don't quite get it; try again.

Voice: Wa-wa.

Bird: Who did you say?

Voice: Wa-wa.

Bird (stalling desperately while trying to think of a name different from that of any deceased relative or friend): Did you say . . . Harry?

Voice (joyfully and with absolute clarity): Yes; Harry.

Bird: Oh, Harry, you said; is that you, Harry?

Voice: Yes; it is Harry.

Bird (after giving it time to wa-wa some more, which it wouldn't do): Well, Harry, that's fine. But Harry; suppose you try to give me your last name. It would be quite evidential if you could do that.

Voice: Wa-wa.

After it had wa-wa-ed several times, and I had encouraged it each time, I finally was able to dig out of nowhere a name that I was certain meant nothing to me: Meyer. I supplied it, as I had supplied the Harry; and the voice immediately became articulate long enough to say "Yes; Meyer. Harry Meyer." Then it lapsed into wa-wa again.

I was extremely interested to learn how long I could keep this business up, and how long Harry would keep it up. So while I was inventing a collision between an automobile and a telephone pole which might reasonably stand as the agency of Harry's demise, I got off some such patter as the following, punctuated by Harry's faithful wa-wa-ing at appropriate intervals.

"Suppose you speak to me, Harry; see whether you can tell me something of the circumstances under which you died."

Here Harry recovered from the wa-wa's sufficiently to articulate, distinctly, that he never had died. I explained to the company that I had inadvertently used the wrong word; that Harry's expression for what had happened to him would be "passed on." I substituted this and renewed the inquiry, and Harry lost his command of English and relapsed into the wa-wa tongue again. But I stuck to the subject:

"Come, Harry, can't you give me something about the manner in which you passed away? Perhaps you can indicate whether you died a violent death? Did you pass over by violence, Harry? Did you (here I made what I hoped would stand for a painful effort to select words that should not reveal too much) pass on suddenly? Was it—was it an accident?"

At this stage Harry was convinced that it must have been an accident, and he regained his speech long enough to say "Yes" most emphatically. But my construction of a personal identity for him was rudely interrupted. My colleagues, Messrs. Walker, Lescarboura and Munn, had been struggling with their risibilities for some time. Mr. Munn's sense of the humor of the situation got away from him, and to my horror I heard a loud snicker from his direction. The percussion set off the two gentlemen at my right, who burst into outright laughter.

I was afraid that everything was off, but I tried to save something from the wreck by saying, in as severe a tone as I could muster: "Gentlemen, there is nothing to laugh at." This was effective in silencing them; but unfortunately for the continuation of my demonstration with Harry Meyer, Mr. Smith took the cue from me, and proceeded to read them a lecture which was even funnier than my efforts to drag articulate speech out of Harry. He indorsed my remarks thoroughly and enthusiastically, stating with great severity that this was a mighty solemn occasion, and that it was painful indeed to have it marred by mockery. That it was a very serious and solemn and sacred business being thus led into the presence of the dead, and

(*Continued on page 69*)

Radio Notes

Static, as a matter of fact, does not hinder radio telephone reception to an alarming extent. In this respect radio telephony has one great advantage over radio telegraphy. For instance, speech can be carried on after a fashion in extremely noisy public assemblies. The ease in understanding speech under such circumstances is due to our life-long experience. Then, too, there is what may be termed "assistance of context." By this is meant the ability of the average listener to fill in lost words which make sense to the entire sentence. However, static is disagreeable, especially when listening to something quite specific such as figures, prize fight reports from the ringside, baseball games, and so on. Since static and signal are amplified alike, it would seem advisable to suggest less frequent use of the loud-speaker in favor of head 'phones when intense static exists. Vacuum tube amplification, especially audio, should be reduced to a minimum consistent with signal strength. At any rate, during the summer season it is well to give up long-distance or DX reception, and confine one's activities to the reception of nearby broadcasting stations with as small an aerial as possible, and without amplification. Amplification generally serves to increase the troublesome static in greater proportion, so it seems, than the music or talk being broadcasted.

An Unforeseen Expense.—It has been the custom of most radiophone broadcasting stations to ask their listeners to write in, 'phone, or telegraph, stating how the programs were being received. Until now no harm has ever come of this practice and, if anything, it has added another thrill to radio broadcasting. One station at least has been offering prizes for the first listener to report from each State. However, it remained for the mayor of San Francisco to add the proverbial straw which broke the camel's back, and the old established practice of soliciting telephone calls and telegrams and letters may have to be modified or made more plain in the future. At any rate, according to press accounts, it appears that Mayor Rolph, in dedicating a local broadcasting station, said into the transmitter: "I want to find how far my voice is carrying, how big my audience is. Send me telegrams and send them collect. Come on—everybody. Mayor Hylan, of New York, and you, Mayor Curley of Boston—everybody!" Well, everybody must have responded. Telegrams piled up on the Mayor's desk. By the following day the telegraph tolls had already exceeded $3000 and were still rising. The Mayor, pleased at first, must have changed his mind later; but there was nothing to be done. He had called for such responses. In the future radio-phone speakers will no doubt be more modest in calling for telegraphic response from the audience, and will make it clear that such messages of appreciation must be paid in advance.

The Case of Loose Connections.—If there is one predominating cause of trouble at the bottom of radio failures, it is poor connections. The present radio broadcasting interest has passed into a new phase, the build-your-own phase, instead of the buy-a-complete-set phase of a year ago. As a consequence all kinds of receiving sets are to be seen, the result of good workmanship and poor workmanship, real knowledge of radio and almost total ignorance of its very essentials, and excellent parts and inferior parts. Many of the home-made contraptions of the poorer order are not functioning, and as a consequence the leading radio enthusiast of every locality has plenty to do in the way of dispensing radio advice and assistance. From our own personal observation we can state emphatically that nine-tenths of the radio failures are due to poor connections. Much of the cheap radio material now being sold is so poorly designed and constructed that a positive connection cannot be counted on. Variometers and vario-couplers of the cheap variety have poor connections between the rotor and the stationary member. Even if the connections have been properly made according to accepted hook-ups, one cannot rely on them because of the uncertainty of continuity. So, one of the first principles which should be observed by all builders of radio receiving sets, whether small or large, inexpensive or elaborate, is to make sure of every connection and, if possible, solder every splice. Little flexible jumpers or pigtails should be used to make positive connections through variometers, vario-couplers and variable condensers of inferior construction.

Radio Notes

Radio and the Fishermen.—Herring fishermen off the Swedish coast are being kept posted on the location of schools of fish by radio telephone. These tips on the whereabouts of the herring have resulted in an increase of efficiency on the part of the fishing crews. On an average they return with a hold filled with fish more often than they have done before the installation of radio. Germany, it will be recalled, was the first country to make extensive use of radio in connection with fishing operations. However, the German application of radio was limited to radio telegraphy, and called for a knowledge of the telegraph code on the part of the fishermen making use of the service.

Wireless Telephony and Telegraphy Compared.—This is an abstract of a report of a sub-committee of the Radio Research Board of the Department of Scientific and Industrial Research. The possibility of establishing satisfactory radio telephone communication on a commercial basis for a distance of 3000 miles or more is considered to be remote. The power for radio telephone services is estimated to be from 3 to 20 times greater than that at present considered necessary for similar radio telegraph services for the same range. For medium ranges, say 1000 miles, the difficulty as regards a commercial service are practically the same as those for longer distances. The position as regards short-distance communication (200 miles or under) is considered to be more hopeful. The conditions requisite for a commercial service are enumerated and the extent to which these can be met is stated.

The Speaking Flame.—It begins to appear as though the carbon microphone, which has long been employed for the conversion of sound waves into electrical variations in wire telephony and radio telephony, is doomed to extinction—at least as far as the radio end of its application is concerned. For wire telephony it must continue in use, because it is simple and fairly efficient; but for the transmission of radio programs the usual carbon microphone is by no means satisfactory. We have already told of the Pallo-photo-phone transmitter used in the WGY broadcasting station of the General Electric Company, and the glow transmitter in the KDKA Westinghouse station. Now we have to report the DeForest speaking flame transmitter, which is a development of Dr. DeForest's phonofilm or talking pictures. "Take the ordinary bat-wing gas burner or a certain form of Welsbach mantel gas light, or special forms of oxy-acetylene gas flames, insert two heat-resisting electrodes therein, in proper relation to the flame and to each other, connect these electrodes to an appropriate electro-motive force, and you will then have an extremely sensitive sound converter which gives an electric reproduction of the sound waves in the air enveloping the flame, which is of an entirely different order of fidelity from that ever obtained from any form of microphonic device, using a diaphragm, whether this be of the carbon, electro-magnetic, or electro-static variety." states Dr. DeForest. "In my phonofilm work we have found in the same way that when a series of very fine and very short platinum wires are heated to a dull red from a local source of current, the resistance of these wires changes, alternately increasing and decreasing in conformity with the sound waves impinging thereon; so that from a telephone transformer connected in series with a battery and this thermo-microphone, a remarkably faithful representation of the sound waves is obtained, even though the frequency of these be as high as 3000 per second. The sensitiveness of this device is greatly enhanced through a gentle stream of air, by fluid evaporation in the neighborhood, or by other auxiliary means. Of all the diaphragm types of transmitters, unquestionably the electro-static type as perfected by engineers of the Western Electric Company, comes nearest to approximate perfection. While this is extremely insensitive compared with the best carbon microphone types, there is no comparison between the fidelity of reproduction by the two means. But one listening in a telephone to the reproduction by means of the flame microphone, and then by means of the electro-static microphone, will at once exclaim that the fidelity of reproductions in the first case is of quite a different order from that obtained even from the highly perfected diaphragm of the best electro-static microphone."

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Radio Notes

Ocean Steamer Has Two-Way Radio.—On the last voyage of the White Star liner "Majestic" radio messages were exchanged with shore stations of the Radio Corporation at speeds of more than 80 words per minute when the vessel was a thousand miles at sea. In order to effect two-way high-speed telegraphic service on the vessel it was equipped by the Marconi Company of England with a high-speed receiver which worked most satisfactorily. High-speed signals were also received from Paris at a distance of 800 miles at a speed of 80 words per minute.

The New Wave Length Regulations.—To clear up the muddle which has gradually come about as the result of the rapid growth of radio broadcasting and the unexpected multiplication of broadcasters, the Department of Commerce has issued a revised schedule of wave lengths which went into effect on May 15 last. The new schedule is the result of the extensive deliberations of the recent National Radio Conference, which were discussed in past issues of this journal. In brief, definite wavelengths have been allocated to each of five zones into which the country has been divided, and broadcasting stations will have to adhere to these or suffer the penalty of loss or suspension of license.

For the Class B stations (the high-power transmitting agencies) there will be ten wavelengths in each zone, and each of these will be adjusted so as not to conflict with any other.

Of the ten zone lengths assigned to Zone 1, which extends from New England through the District of Columbia, three of them, 405, 455, and 492 meters, have been assigned to New York City and Newark. This is because so many persons are served by the stations in the neighborhood, and so much entertainment talent is available. The stations in New York and Newark will have to arrange for division of time.

Other assignments of wavelengths thus far in this zone are:

Springfield, Mass. (Westinghouse station) and Wellesley Hills, Mass., 337 meters.

Schenectady (General Electric), and Troy (Rensselaer Polytechnic), 380 meters; Philadelphia (Wanamaker's, Lit's, Strawbridge & Clothier), 509 and 395 meters, and Washington (Arlington and Radio Corporation), 435 meters. It is likely that Arlington will have a special wavelength and not be forced to divide time with any other station. Wavelengths of 303, 319, 469 meters also are reserved for this zone.

Assignments in the other zones up to this time are:

Zone 2—Pittsburgh, 326; Chicago, 448; Davenport and Des Moines, 484; Detroit and Dearborn, 517; Cleveland and Toledo, 390; Cincinnati, 309; Madison and Minneapolis, 417.

Zone 3—Atlanta, 429; Louisville, 400; Memphis, 500; St. Louis, 546.

Zone 4—Lincoln, Neb., 341; Kansas City, 411; Jefferson City, 441; Dallas and Fort Worth, 476; San Antonio, 385; Denver, 323; Omaha, 527.

Zone 5—Seattle, 492; Portland, 455; Salt Lake City, 312; San Francisco, 509 and 423; Los Angeles, 395 and 469; San Diego, 536.

None of the wavelengths goes above 600 meters. This is important to amateurs, as according to a plan proposed to the recent conference the large stations might have had wavelengths up to 700 meters, which would have necessitated the changing over of many receiving sets.

Besides the Class B stations, which broadcast to long distances, there are 540 Class A stations which use the 360-meter wavelength. These will be allowed to retain that wavelength or can come into a special band between 222 and 300 meters. If a new station is erected and it cannot meet the qualifications of a Class B station it will not be allowed to use 360 meters, but must go into the 222-300 band.

Because of the great activity in radio, the Department of Commerce is enlarging its forces in the inspection districts of which there are nine with Boston, New York, Baltimore, Atlanta, New Orleans, San Francisco, Seattle, Detroit, and Chicago as headquarters.

Beginning May 15, inspectors will check the wavelengths of stations in their districts.

It was stated that any station now operating on 360 meters has the privilege of remaining on that wavelength. It is also emphasized that the assignments of wavelengths are for cities and not for specific stations.

Our First Test Seances

(*Continued from page 65*)

that he was very sure that if any of these gentlemen were to think that his dear departed mother had come to him and he had met her with a sneer, he would regret it for the rest of his life. That he and the medium had come here to put this thing over, this great message. That they weren't here for the money prize; that if the medium wanted only money, he (Mr. Smith) had ten times $5000 in his pocket that he could hand right over to him. They had come here to put this thing over, so that we might all know about it, without any doubt or suspicion of fraud. I had begun to fear that he would not finish at all, but he did, with an exhortation for all of us to get in a real happy and receptive frame of mind for the phenomena. But Harry was gone, and wouldn't come back.

Well, there we are. I don't suppose it is necessary to state specifically that the name Harry Meyer means absolutely nothing to me; or to insist again that while the "spirit" voice which claimed that name was absolutely unable to make an articulate sound save in repeating what I had put into its mouth, in doing this it could talk as plainly as I can.

Through a premature statement by a member of our committee, the medium learned from the daily papers that he had been observed to be frequently out of his chair; but he did not learn the observed coincidence of these absences with the major phenomena of the seance. He called upon us immediately, for the purpose of "explaining" the record. The substance of this explanation was that, at times during his seances, he is lifted from his seat by the spirit forces. In support of this claim, he reminded us that he had made it twice during the seance. The fact is, however, that on neither of the occasions when he advanced the claim that he was being lifted, did the light record his absence from the chair; while both claims came after he had discovered the curious nature of the footing under the chair.

In view, then, of all the facts which I have put down, and of numerous others that have been squeezed out by the demands of space, the sub-Committee considering Mr. X's mediumship finds it possible to make a definite report on the basis of these three sittings. This sub-Committee consists of Drs. Prince and Carrington, and Houdini. It finds that the medium has failed to give any evidence whatever that his mediumship is genuine. It therefore rules (see the statement of the conditions of our offer, in our January issue) that the medium has failed to qualify for further investigation by the sub-Committee or the full Committee; that his mediumship stands rejected; and that his claim to the prize and to the Committee's further attention stands vacated.

Trapping the Burglar

(*Continued from page 7*)

burglars were not apprehended. A good many innocent tramps and idle young men suffered jail terms, to be sure, but the authentic robbers escaped.

One of the worst sufferers by the misdeeds of the mysterious criminals was the owner of the local mill. He had been burglarized at least a dozen times. Finally, without consulting anyone, he rigged a set-gun in his place and waited results. At the end of the first week the miller found that his gun had been discharged and discovered traces of blood inside and outside his premises. A thin trickle of red was followed by the police and led to the home of Charles Adams, the town's first citizen. After a dramatic trial Adams was sent to prison and later escaped, it is said, by inducing hypnotic sleep and being carried out of his gaol in a coffin.

Similar ironic comedies have followed the employment of the set-gun in other communities. But pathetic or even tragic results have been the usual upshot of such drastic remedies, with the result that laws have been passed against this kind of thief traps in various localities.

The late war, with its vast employment of poison gases, has had a very definite effect upon the development of explosive thief catchers and burglar alarms. In New York City alone there are today a dozen makers of various kinds of asphyxiating devices aimed at the nocturnal prowler. I remember with considerable nervousness my first contact with one of these mechanisms and its inventor. He had followed me to a nearby summer resort for the purpose of demonstrating his goods and finally overtook me in the lobby of a certain famous hotel, where he backed me into a corner and brandished

a heavy cane in whose tip was a tear-gas bomb, powerful enough, he assured me, to "lay out every man, woman and child in this place." Soon afterwards he was committed to a sanitarium.

This is not told by way of reflecting upon gas bomb alarms and burglar protection in general. In cities like New York, Chicago, Philadelphia and Detroit a new kind of snatch-and-run robber has been operating for several years. Their practice is to smash a jeweller's window or pounce upon an exposed cashier, grab all the diamonds or cash within easy reach and run for it. The jobs are so quickly done that ordinary burglar alarms are useless. The robbers are gone before help can arrive. Against such snatch robberies the asphyxiating bomb has been considered highly useful, and a good many devices using such petards are now installed in several principal cities. I suppose there must be several thousand of them employed in New York.

To foil the payroll bandits infesting every city, cartridges containing chemicals which instantly give off an asphyxiating gas have also lately been fixed to the satchels which bank messengers and payroll auditors carry to and from banks with considerable amounts of cash. There are, to be sure, many other kinds of alarms designed for the protection of these money bags. One type starts a gong inside the satchel which cannot be shut off and continues to ring till the robber drops it or the mechanism runs down. Another type fires one or several cartridges to attract the attention of passersby or officers. Thus the gas bomb is only the latest development in this field.

Probably the most advanced and intricate system of burglary protection by means of asphyxiating gas has been invented and is being distributed by a veteran New York theatrical man. This gentleman affixes to doors and windows a simple enough mechanism which fires a shell containing salts that are instantly ignited and fill the room with choking fumes of sufficient power to lay out a burglar if he has managed to get inside, or definitely to repel him if he is still in the act of entering. At the same time the device sets off a series of rockets held in a bracket on the outside of the building. Up go the fireworks, exploding high in the air with loud detonations and showers of stars.

Attached to this arrangement is a numeral indicator on each floor of an office or loft building, which indicates by dropping a number the location of the burglarized room. A third connection sends the alarm to the nearest police and fire stations. The same inventor has worked out a system of protecting windows with hollow steel bars. In the core of each of these is a rolled sheeting of fulminate enclosing the gas salts. If an attempt is made to cut the bars the fulminate ignites, sets off the gas-producing substance, blows poison fumes into the robber's face and fires the rockets.

Without in any way discounting the worth of such burglar defenses, their dangerous properties need to be recognized. Recently a police officer having seen a light burning within, entered premises in Thirtieth Street, New York. He was not aware that there was a gas alarm, with the result that the bomb was set off, the policeman was knocked unconscious and severely gassed. Such accidents are certainly likely to happen to users and to innocent visitors as well. Again, the danger to firemen in case of conflagrations must be considerable unless special defensive mechanisms or precautionary methods can be developed.

There seems to be no question that we shall shortly find ourselves in the midst of anti-burglar and thief devices controlled by wireless. Here we shall probably have developments which will make all the curious miracles of the past in this field seem tawdry and pale.

Transplanting Insects' Heads

A REMARKABLE experiment has been tried at the Biological Research Laboratory of the Vienna Academy of Sciences by Dr. Walter Finkler who, in order to solve certain problems connected with the correlation of body and soul, cut off and exchanged the heads of insects duly narcotized. The head having been lifted out of the thorax socket, was severed from the trunk by a simple stroke of the scissors and transferred to another individual treated in the same manner. The blood thus escaping, which, by the state of narcosis, was reduced to a minimum, immediately closed the edges of the wound and, without any seams or other means of fixation, merely in virtue of its natural adhesion, kept the head in the position most suitable for healing.

In order to test the functioning possibilities of transplanted heads, the behavior of beheaded insects was first investigated. A decapitated *Hydrophilus* was found unable to move about either in water or on the soil, while all other insects submitted to these tests likewise proved incapable of any coordinated movement. All these phenomena, however, would disappear within two or three weeks of putting on a new head.

Our Psychic Investigation in Europe—III

(*Continued from page 20*)

diumship is more clearly drawn than some of us realize, more clearly perhaps than some of us find agreeable. That some mediums do employ fraud on occasion is admitted. This is explained on the ground that the medium is of intelligence just sufficient to feel that she is under fire and must make good; that her psychic powers are uncertain and often refuse her; and that when this occurs she produces as best she can the results which she feels to be imperative. This involves the assumption that there is such a thing as psychic power. We may, if we are able, refute this assumption by a showing of fact; but it is only after our assumption that we shall have the facts. Until then we may not quarrel with this assumption. It is one of several that have been advanced to explain certain observations, and we cannot throw it out any more summarily than we may throw out the explanation that all mediums are crooks.

Accordingly, it is not inconsistent, as might at first appear, to speak of a given psychic performance as partly genuine and partly fraudulent. It is regrettable, if the intelligence of the psychic sensitive is not sufficient to sort the two out for himself; but if it is not, and if we are to admit that genuine phenomena as well as fraudulent ones perhaps occur, we must come prepared to do our own sorting.

This is all very well; but the psychic proponent does not stop here. He wants us to deal in exactly the same way with the medium who has been caught faking, the medium against whom strong presumption of faking but no proof exists, and the medium against whom no good evidence of fraud has been found. This is altogether too severe a demand upon our patience. A highly prejudiced speaker in my presence recently pictured a psychic investigator as saying: "I have sat fifty times with this medium. Forty-nine times I have caught her cheating. The other time I did not catch her. Therefore this fiftieth performance was genuine, and she is a great medium." This of course is grossly exaggerated, but it points in the right direction. We must avoid the error into which it assumes that we have fallen. The medium who is known to have cheated cannot possibly hope for such favorable treatment as the one who is not known to have cheated. Even the presumption that fraud has been committed, if a reasonable one, works the same way. And finally, to touch a sore spot: the knowledge that a given performance or a considerable part thereof can be duplicated by sleight-of-hand does not prove anything at all against the medium. But in the presence of such knowledge we are certainly justified in meeting both the medium and the portions of his performance for which the conjurer has no present parallel, with a greater reserve than would be appropriate in its absence.

In the seance which I have described, the psychological arguments against fraud seem rather strong, but are of course far from conclusive. If we pass them over, we find that the greater part of the sitting could have been done, with comparative ease and little danger of detection, through fraud on the part of one or two of the sitters. There is no doubt in my mind that some at least of the phenomena were so produced. Where to draw the line and whether to draw it at all are questions of great difficulty. In spite of this, and with due admissions regarding the unsatisfactory conditions of the seance—a dark sitting with thirteen participants can never prove anything—it seems to me reasonably probable that genuine phenomena occurred. But I must emphasize that this is a purely personal judgment, formed upon grounds that are really inadequate for the formation of an opinion in which one can have confidence, formed upon these grounds only because they are the only grounds presenting themselves, and formed with full realization of its inadequate character. And I must insist that it be not taken as a scientific opinion, or be quoted as scientific authority on behalf of the existence of psychic

phenomena. It really means nothing other than that, after attending this and other seances, the occurrence of genuine psychic phenomena of a physical character impresses itself upon me as less improbable than I should have judged it to be in the absence of this experience.

Elevation and Range of British Naval Guns

(Continued from page 26)

shock to which the structure is exposed when the gun comes crashing down in recoil. It may even be doubted whether the speed with which the gun can be loaded at so high an elevation is equal to that when it is nearer the horizontal. The net gain in all-round efficiency is therefore decidedly problematical.

The position, then, is this. The battle-cruiser "Hood," armed with the 15-inch Mark I gun, firing a 1920-pound projectile at a muzzle velocity of 2450 foot-seconds, can shoot 30,100 yards with her 30-degree mountings. *But all the other ships of the British battle fleet have only 20 degrees of elevation*, and their extreme range is therefore 24,000 or 20,000 yards, according to whether they carry the 15-inch or the 13.5-inch gun.

There is an impression in England that the American fleet already includes several ships with their main battery guns mounted for at least 30 degrees' elevation, viz., the "Maryland," "Colorado," and "West Virginia," if no others; and as these vessels are armed with a 16-inch 45-caliber piece, their range, 30 degrees, ought to be well above that of the "Hood's" 15-inch 42-caliber guns. The popular notion that increased elevation gives much longer range is illusory. For instance, if the "Hood's" guns were converted to 40 degrees, the gain in range would not be more than 4000 yards. Apart from the angle of firing, gun range may be increased either by using specially-shaped projectiles—with stream-lined "wind-cheating" noses, like those used by the French at the land front during the war, and similar to the German "Spitz-Granate" employed for very long-range bombardment by heavy guns—or by reducing the factor of safety, *i. e.*, increasing the propellant charge; or by listing the ship. All these expedients were tried during the war, but all have manifest drawbacks. Little need be said here as to the actual *military* value of what may be called super-range in ships' artillery. In theory, hitting is possible up to the extreme limit of range; in practice, the percentage of hits obtained at anything above, say, 24,000 yards, on a target moving at high speed and on a varying course, would probably be nil.

Industry in the Philippines

(Continued from page 29)

3,500,000 liters a year have to be imported to meet the demand. Filipinos are very moderate drinkers.

From liquor we can innocently pass to fruits of which the Philippines have innumerable varieties. The yearly yield of fruits of all kinds is estimated at $15,000,000 a year and is all locally consumed. The canning of mangoes, declared to be the choicest, and most delicious fruit in the world, has been undertaken by Americans to let their brethren back home have a taste of the life of the tropics.

A study of industrial conditions in the Philippines would be incomplete if public utilities, of which we have too few, were left unmentioned.

In the city of Manila an American company owns and operates the electric light, power and street-car service since 1905. The Manila Electric Company, a $14,000,000 property, operates 50 miles of trolley with 160 cars of American make and furnishes light and power to 37,000 customers. Its power plant, of 22,000 horsepower, is the most modern in the Far East, being equipped with the latest type of stokers and electric apparatus. The power is generated by steam; the coal used is anthracite from Indo-China, which is of the same character as Pennsylvania anthracite but with more heat units. The high-tension and low-tension electrical distributing systems comprise approximately 1000 miles. The poles are of concrete and Ipil, a Philippine wood. The track construction consists of a generous foundation of crushed stone. High T-rail of the type used in the United States is employed. The car house and repair shops are of cement and steel. Manila is justly proud of its most efficient public utility.

Manila's telephone service is conceded to be the best in the Orient. There is a telephone to every 25 persons in Manila. There is a gas corporation in the city which fur-

nishes gas for cooking purposes, and reports increasing patronage. The city has splendid water and sewerage systems. The firm that constructed them is responsible also for most of the bridges, edifices and other constructions in the country. It has iron and brass foundries and modern shops manufacturing steel structures, steel barges, tugs; also bolts, knots and shapes. The raw materials are imported from the United States. There are slipways, ship yards, drydocks and big ship repair shops. The building industry is a growing one. Commodious buildings in Manila are being built of reinforced concrete. All public buildings are similarly built.

The Manila Railroad Company, a Government-owned line, has a mileage of 646 in operation. The road is 42-inch gage. The line is laid with 65-pound rail. The original construction was English as well as the equipment. The unit of the original rolling outfit is a seven-ton, four-wheel box and the engines were from 18 to 30 tons dead weight. Recently Porter 72-ton and American 124- and 127-ton locomotives were added to the equipment. The line is being Americanized in equipment to promote efficiency. The line which traverses a wonderfully fertile country is very valuable property and a bright future is generally predicted for it.

The Philippine Railway Company, an American company, operates 72 miles of main line on the island of Panay and 59 miles on the island of Cebu, which are both fast-developing territories.

Hydroelectric power is not yet harnessed. The Agus River in Midanao is estimated to be able to develop 350,000 horsepower; the Agos River in Tayabas, 55,000 horsepower; the Angat River in Bulacan, 9000 horsepower, and the Agno River in Pangasinan, 80,000 horsepower. Extensive irrigation projects have been constructed, and it is expected that the production of rice, the first article of diet of the people, will be increased to meet the demand without importing any from abroad.

Underpinning the Washington Monument

(*Continued from page 32*)

ing from the top of the slab, on a line 13 feet and ¾ inch inward from its outer face, there was built a continuous concrete buttress, which sloped back to the upper face of the old rubble foundation and was carried back 18 feet within it, the total width of the buttress at its base being 28 feet 2 inches.

Since that portion of the shaft which was already completed with its foundation was 180 feet in height and weighed 35,750 tons, it was obviously necessary to place the concrete buttress section by section, breaking out a certain portion of the old foundation at a time, and building the new work in the space thus prepared for it. The new foundation rests on a bearing surface of 16,000 square feet as compared with 6400 square feet for the original.

Capt. Weart states that the entire work of underpinning was accomplished without causing the slightest crack or the least opening in any joint of the 180 feet of the existing monument. The new foundation rests upon a bed of fine sand two feet in thickness, below which is a bed of boulders and gravel. Borings were made in this deposit for a depth of 18 feet, without passing through it. Work was resumed on the shaft in August, 1880. The first 13 courses, 26 feet, were faced with white marble from Massachusetts. The remainder of the shaft to the top is white Maryland marble, similar to that used in the lower section. The new work was backed with dressed New England granite to the 452-foot elevation, above which the walls are entirely of marble of through-and-through blocks. From the level 470, where the ribs of the pyramidion begin, the courses are secured to each other by mortises and tenons cut in the builds and beds of the stones.

The pyramidion, which is 55 feet high, is supported on 12 marble ribs which spring from the interior face of the walls at the 470-foot level. The outside covering slabs are only seven inches in thickness, and they are supported on inwardly inclined marble ribs. The monument as finished, carries a solid capstone which weighs 3300 pounds. This was set in December 6, 1884, and marked the completion of the work.

As finished, the monument is 555 feet 5⅛ inches in height, and its weight is so distributed that, if it were ever subjected to a wind pressure of 100 pounds per square foot, representing a wind velocity of 145 miles per hour, it would show a large factor of safety against overturning.

The Monument Society raised by free-will offering the amount of $300,000; the balance of the total sum of $1,187,710 representing the cost of the monument, was provided by the Government.

Draining Land With Gasoline

(*Continued from page 34*)

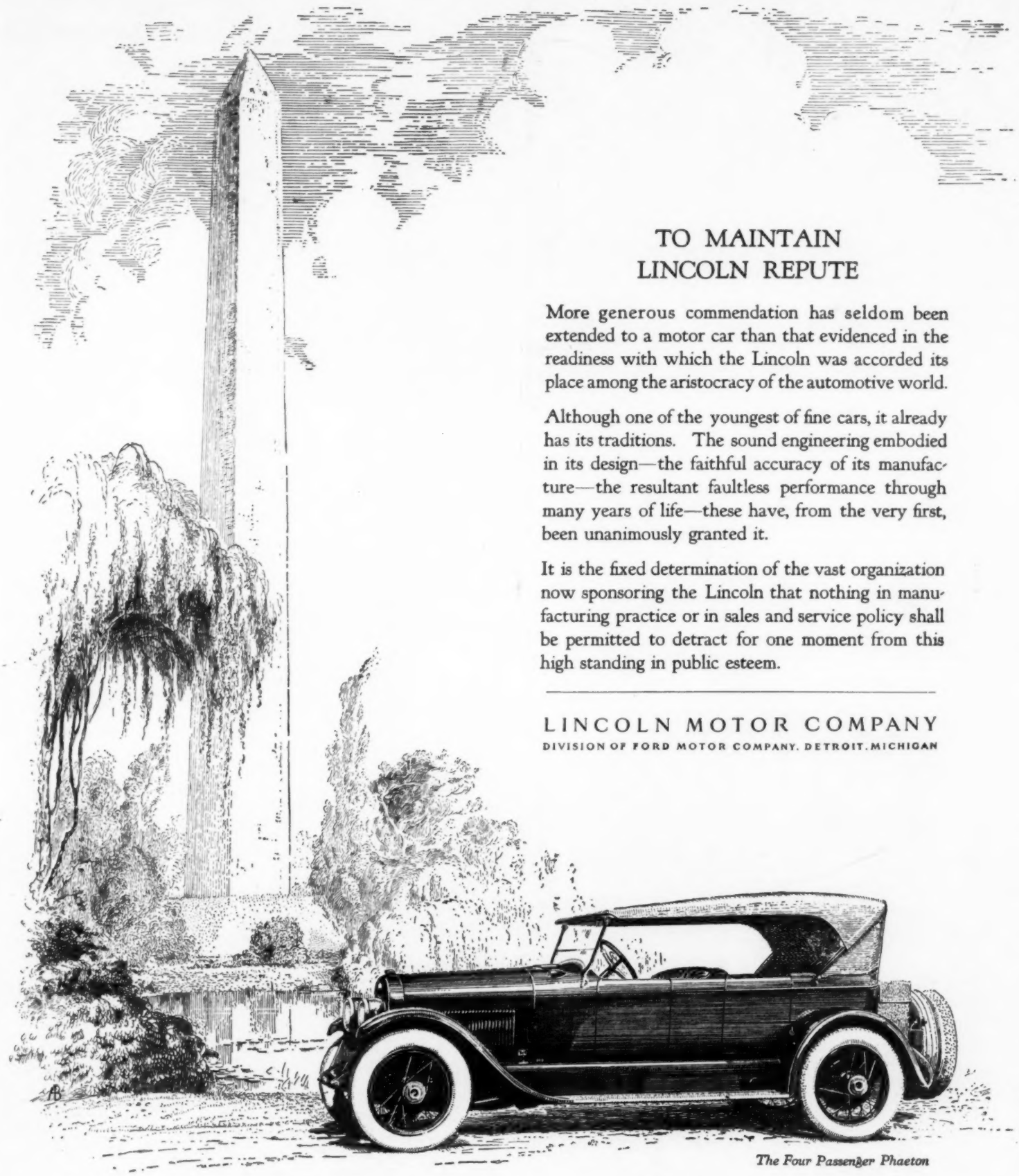
The wheel excavator is equipped with steel bed frames, securely braced, permitting the mounting of power apparatus thereon. Internal-combustion engines, consuming gasoline, kerosene, naphtha, or alcohol, are used, though steam engines and boilers are sometimes preferable. The machine is supported upon two pairs of wheels, the front pair being provided with flanges to avoid slipping sidewise from the line of the ditch. The rear wheels, broad and large, carry the bulk of the weight. Not infrequently, the wheel excavator is fitted with apron or caterpillar tractors instead of rear wheels. Digging is accomplished by buckets upon the rim of a large wheel which is revolved in the trench. As each bucket reaches the top of the circle the dirt is dumped upon a conveyor belt, which can be shifted to deposit the upturned earth upon either side of the ditch. Friable soils suggest that these machines be equipped with shields, following close behind the digging unit, keeping the trench open until the tile can be placed.

Not unlike the wheel in working principle, the endless chain machine has a steel bed-frame upon two pairs of wheels, and upon this base is carried the steam engine and boiler and internal combustion engine. Apron tractors are frequently substituted for the rear wheels. The digging unit is driven by means of a sprocket wheel at the upper end of the frame, and receives its power from the engine by means of a chain or belt drive. After terminating their upward movement, the buckets empty their contents upon an endless belt which conveys the soil to a sufficient distance from the trench so as not to roll back on to it. As a precaution against the trench caving before the tile is buried, shields can be attached. One manufacturer markets a machine capable of cutting a ditch from 15 to 24 inches wide and any desired depth not exceeding ten feet. This outfit is equipped with tractors and is operated by a 28-horsepower, four-cylinder gasoline engine. Its road speed is 1½ miles per hour, and its digging capacity is eight to ten feet per minute. This equipment weighs 8½ tons, can be operated by one man, and sells for $6800.

The scraper excavator is merely an adaptation of a machine originally designed for cutting huge ditches. A swinging boom is mounted on the bed of the machine and the bucket or scoop is suspended from a cable running through a sheave at the outer end of the boom. The drag bucket is filled by being drawn toward the base of the boom by means of a second cable. Forthwith the bucket containing the material excavated is elevated by the boom line and the boom then swings it to the dumpline. If desired, another cable from the hoisting engine may be run over a sheave at the end of the boom to lift the tile into place from beside the trench. Steam or gasoline power is capable of accomplishing all the work of digging, swinging and dumping the dirt, and of lifting the tile in place. The machine costs approximately $5500.

Both horse-drawn and power-operated implements are utilized in back-filling the tile trenches. For shallow ditches the practice is to use a moldboard plow, while a V-shaped drag can be employed to advantage. Suited to back-filling of large ditches is a power-operated machine which travels along one side of and parallel to the ditch. When the material at a given place has been deposited in the ditch, the machine moves forward and takes up a new station directly opposite the succeeding section to be filled. It has a capacity of seven buckets of soil per minute and is operated by a ten-horsepower gasoline engine. The market price is $2000.

The costliness of machinery for laying tile has given an impetus to a movement for community tile drainage wherein the farmers of a particular locality invest in adequate equipment for cooperative use. A notable example is the project undertaken in 1917 as a war measure by the New York Food Supply Commission. Three traction trenching machines were purchased and during the following year the Commission accepted responsibility for the continuation of the cooperative enterprise, acquiring ten additional machines at a cost of $50,000. One hundred and fifty farms were visited. 40,000 rods of trench were cut and over 12,000 acres were benefited by adequate drainage.



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